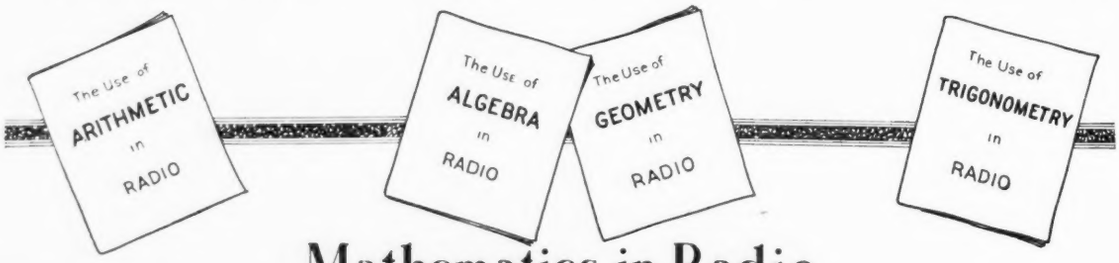
SHORT-WAVE NUMBER

RADIO NEWS

Auto Radio
5 S. W. Receivers
Electric Music

How to Make:
A Head Amplifier for the Condenser Microphone

RADIO NEWS LIBRARY SPECIAL OFFERS



Mathematics in Radio

DURING 1931 there was published in RADIO NEWS a series of articles describing the use and application of mathematics in radio, written authoritatively by Mr. J. E. Smith, President of the National Radio Institute, of Washington, D. C.

These articles begin with the simple rules of Arithmetic, and extend through Algebra, Geometry, and Trigonometry. Each subject is treated carefully, and in simple terms, clearly illustrated with easy-to-read diagrams and charts.

At the insistent request of our readers, we have arranged to have these articles reprinted in booklet form, one booklet to each subject. We are now prepared to offer the complete set as illustrated above FREE with each subscription for RADIO NEWS for 11 issues at the special price of $2.

***Special Offer No. 1*—"Mathematics in Radio" FREE with 11 issues of RADIO NEWS for $2**

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101 Radio Hook-Ups — **Now 25c**

Here's a big, attractively bound (Red Bristol) edition of the book that every man interested in radio has been eagerly looking for! As its name implies, this book contains complete diagrams and descriptions of the most popular types of receivers, short-wave transmitters, test apparatus and amplifiers or units thereof used in virtually every field of radio activity. Popular demand has resulted in the publishing of this edition, priced to meet the current market.

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Special Offer No. 9

How to Make Money in Radio Servicing

Written by Zeh Bouck, especially for RADIO NEWS, this book is the answer to the burning question of the hour. Prepared after months of effort, and at great expense, it tells the radio serviceman how to make his business show a profit. And what is more important in times such as these?

The active serviceman, and also the amateur experimenter who desires to turn his knowledge and experience into practical money-making channels, will find this book indispensable. It tells you how, and when, and why to do things. It is practical, up to the minute, and complete.

This book is not for sale at any price. But, you do not need to pay for it—it is our gift to you, with a specially reduced price subscription for RADIO NEWS for the next 7 issues at $1. You save 75c over the newsstand price of the magazines, in addition to securing this book without extra cost.

Special Offer No. 10

Advertising Mat Service — **$1**

Servicemen and dealers will find the mats (nine in all) included in this advertising service will be very helpful and a big saving in connection with their newspaper advertising work. Each one of these have been tried and proven. For full description see page 951, in the May, 1932, issue of RADIO NEWS.

Special Offer No. 11

Radio Trouble-Finder — **Now 15c**

(*Formerly 25c*)

If you do not have a copy of this book in your radio library, here is your chance to get one at a saving. The Trouble-Finder is worth its weight in gold when your radio fails to perform when a big program is on. It tells you what to do to quickly find and repair the trouble.

Special Offer No. 12

23 Lessons in Radio (*With the next 7 issues of* RADIO NEWS) *for* **$1**

Radio men, young and old, needing a reference book which contains the fundamental principles of radio—more experienced men wanting the latest dope on the essentials—all will find "23 Lessons in Radio" the answer!

A Few of the Subjects Covered:

Elementary Radio Theory—The Detector Tube—Construction of a Two-Stage Audio-Frequency Amplifier—How the Radio-Frequency Amplifier Works—A Short-Wave Receiver—Principles of Transmitting and Receiving—Complete Chart of Standard Radio Symbols—How to Build R.F. Tuner—A Three-Stage Resistance Coupled Audio-Frequency Amplifier—The How and Why of B-Power Units—Breaking Into the Amateur Game—A Code Test Outfit—Circuit, Constructional and Operating Details of a Low-Power Transmitter—How the Vacuum Tube Works—Battery Construction Details—How to Analyze Receiver Circuits.

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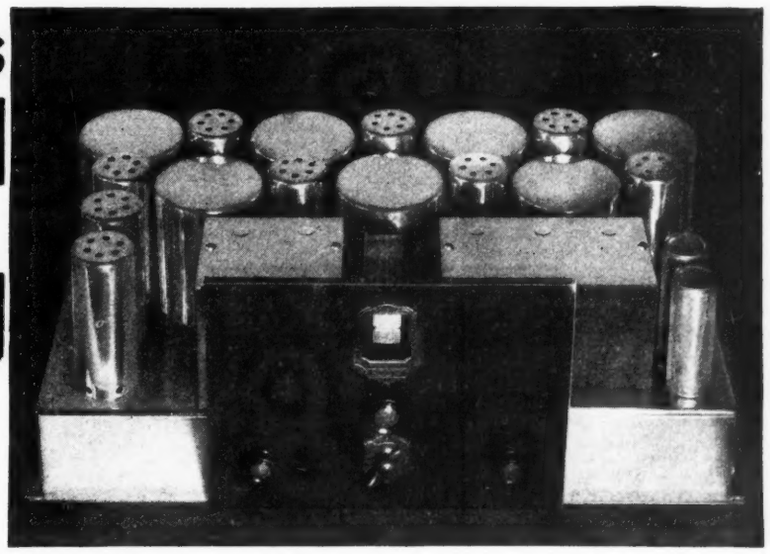
no trimmers



Proved **by independent laboratory tests and by practical use to be the greatest radio achievement of all time!**

Such a receiver as the *de luxe* Scott All-Wave is still generally considered *impossible*. Yet, here it is! A 15-550 meter receiver *without* plug-in coils that tunes the whole range with absolute precision, on ONE dial—*without* the help of trimmers. But that's not all. The *de luxe* SCOTT ALL-WAVE incorporates far greater *sensitivity*, and obviously better *selectivity* than have ever been considered possible of attainment. And with it all, a tonal output that is guaranteed to be as perfect as the tonal input at the station!

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*12/1000ths of a microvolt per meter at 1400 K. C. and 6/10ths of a microvolt at 600 K. C. This is an average of several thousand times more sensitivity than engineers have ever considered practical. And this sensitivity would not be practical even in the *de luxe* Scott All-Wave were it not for the unique means by which this receiver lowers the natural noise level of reception. But it IS practical in the *de luxe* SCOTT ALL-WAVE, and the 12/1000ths to 6/10ths microvolt per meter sensitivity brings in stations, *at most any distance*, with local volume. Stations that no other receiver could ever hope to get, come in on the *de luxe* Scott All-Wave, with enough volume to be heard a block away!

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No receiver in existence today can demonstrate such ideal selectivity as the *de luxe* SCOTT ALL-WAVE. *At 1000 K. C. it gives 4.5 K. C. separation provided the field strength of one station does not exceed the other by more than 10 times. It gives 9 K. C. separation when the field strength of one station exceeds the other 100 times. At 200 times field strength it separates by 10 K. C. At 5000 times field strength, the separation is 20 K. C., and mind you—only ONE dial, and without trimmers of any kind!

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Send the COUPON for Curves and Proof

The story of Scott precision engineering as applied to the development and final attainment of complete perfection in the *de luxe* Scott All-Wave reveals the most outstanding radio facts of the day. The coupon will bring it to you FREE—also unquestionable PROOF that the *de luxe* SCOTT ALL-WAVE Is the ONE receiver that can guarantee easy, enjoyable, dependable, daily, 'round the world reception. Clip the coupon. Send it now.

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4450 Ravenswood Ave., Dept. N-82, Chicago

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4450 Ravenswood Ave., Dept. N-82, Chicago, Ill.

Send me full particulars of the *de luxe* SCOTT ALL-WAVE.

*Name*_____

*Street*_____

*Town*_____ *State*_____

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RADIO NEWS

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VOLUME XIV | August, 1932 | NUMBER 2

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Send the following message, subject to the terms on back hereof, which are hereby agreed to

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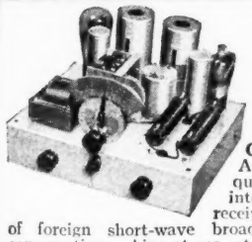
MIDWEST RADIO CORP=
:DURING LAST WEEK I LOGGED THE FOLLOWING FYA PONTOISE GBW
RUGBY HVJ VATICANCITY XDA MEXICOCITY VK2ME SYDNEY VE9GW
BOWMANVILLE 12RO ROME G5SW CHELMSFORD CGA AND VE9DR
DRUMMONDVILLE AMATEUR AND AIRPORT STATIONS FROM ALL OVER
UNITEDSTATES ALSO NUMEROUS SHIP SHORE AND TRANSATLANTIC
PHONES FROM BOTH SIDES AN HAWAIIAN TEST STATION SEVERAL
SPANISH AND GERMAN SPEAKING STATIONS HAVE ALSO BEEN RECEIVED
BUT NOT YET IDENTIFIED HAVE RECEIVED EVERY BROADCAST FROM
FYA MORNING AND AFTERNOON FOR OVER A WEEK WITH WONDERFUL
TONE AND VOLUME THE MIDWEST COMBINATION SET IS CERTAINLY
ONE TO BE PROUD OF
828A
WM S TETER.

...ERN UNION GIFT ORDERS ARE APPROP... ...TIONS

England, Holland, Germany, France, Italy, South America, Australia, Hawaii, Japan



Midwest 4-Tube Short-Wave Converter

Converts any A. C. set of adequate sensitivity into a short-wave receiver for reception of foreign short-wave broadcasts, airplane conversations, ships at sea, etc. Low factory price—completely assembled—now only **$16.75.** Coupon brings full details. Mail it NOW!

THESE sensational new Midwest, ALL WORLD, ALL WAVE 15 to 550 meter sets bring you the WHOLE WORLD of Radio. SHORT-WAVE and standard wave broadcasts not only from U.S. stations, coast to coast, but from many foreign countries, Canada, Mexico, Cuba, Hawaii come in like locals.

Scores of letters on file in our office show that Midwest users are regularly enjoying foreign programs from all over the world. You'll be positively amazed and delighted.

30 DAYS TRIAL: Select the Midwest you want and try it 30 days—free—in your own home. Satisfaction or no sale—that's the Midwest way.

Gets Germany, Italy, France

"March 2nd, I picked up Germany, France and Italy. On the following day, I got Rome again and heard all the music from the Royal Opera House." A. Musconi, 7122 Paschall Ave., Philadelphia, Pa.

Bermuda, Philippines, Switzerland, Rome

"Have picked up Vancouver, B. C.; Hamilton, Bermuda; Geneva, Switzerland; also Philippine Islands and 12-RO, Rome, Italy." Geo. Kuhr, 218 Division St., Bellevue, Ky.

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"I heard VK2ME, Australia, this morning and held them for over two hours." E. Applebaum, 334 Johnson Ave., Newark, N. J.

BUY Direct from Factory — Save 50%

Every Midwest set is fully assembled, thoroughly tested, comes to you ready to plug in, and is backed by an **absolute guarantee of satisfaction.** Mail coupon now! The big new Midwest Catalog shows sensational bargains in 13- and 15-tube ALL-WORLD, ALL-WAVE Combinations, 9- and 11-tube Super Hets., 4-tube Short-Wave Converter and new AIRCELL BATTERY sets. Get all the facts before you buy a radio of any kind.

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Letters on file in our office prove that Midwest owners have logged these and many other foreign stations:

FYA....Pontoise, Fr.
PCJ.....Holland
GBW....Rugby, Eng.
G5SW...Chelmsford, England
HVJ....Vatican City, Italy
12RO....Rome, Italy
VK2ME.Sydney, Aus.
VE9DR.Drummondville, Can.
K6KO...Honolulu, Hawaii
RV15....Russia
F31CD..Indo-China
XDA....Mexico City
HKA....Colombia
OC1.....Lima, Peru
RABAT. Morocco
PRADO.Ecuador

Additional proof from some of the thousands of Midwest users sent with catalog.

MIDWEST 11-TUBE SUPER HET.

only

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BALANCED SUPER-HETERODYNE UNIT, REAL AUTOMATIC VOLUME CONTROL, PIN-DOT SELECTIVITY, LARGE-SIZE ELECTRO-DYNAMIC SPEAKER that reproduces voice or music without distortion. All the latest features. And you buy it direct from the Midwest factory at a positive saving of 30% to 50%. 30 days' free trial—and easy payments if you wish. Coupon brings full details mail it NOW!

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Dept. 94, Cincinnati, Ohio.

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The Editor–to *You*

THE short-wave listener is now coming into his own! With the new receivers described in this issue it is easily possible to sit down any day of the year and listen to stations operating on the short waves from literally all over the world—and some of these receivers cover the broadcast band as well.

* * *

THERE is not the slightest doubt in the Editor's mind but that short waves offer more thrills and newer enjoyment than any other field in radio at the present time. That does not mean at all that the broadcast range of programs has lost appeal, but it does mean that the listener has at his disposal devices that now give him reliable reception of foreign programs—programs of different caste than our own, programs that are quaint, that originate from the Orient and from the Antipodes.

* * *

JAPAN, Australia, Africa, Hawaii, Europe—the world's voices in your ears! Discordant Eastern music, cymbals, foreign tongues, contact with exploring expeditions, a lion hunt, a police chase of criminals, airplanes over mid-ocean, motor-boat races, golf tournaments, war—you meet all of these on the high seas of the short waves.

* * *

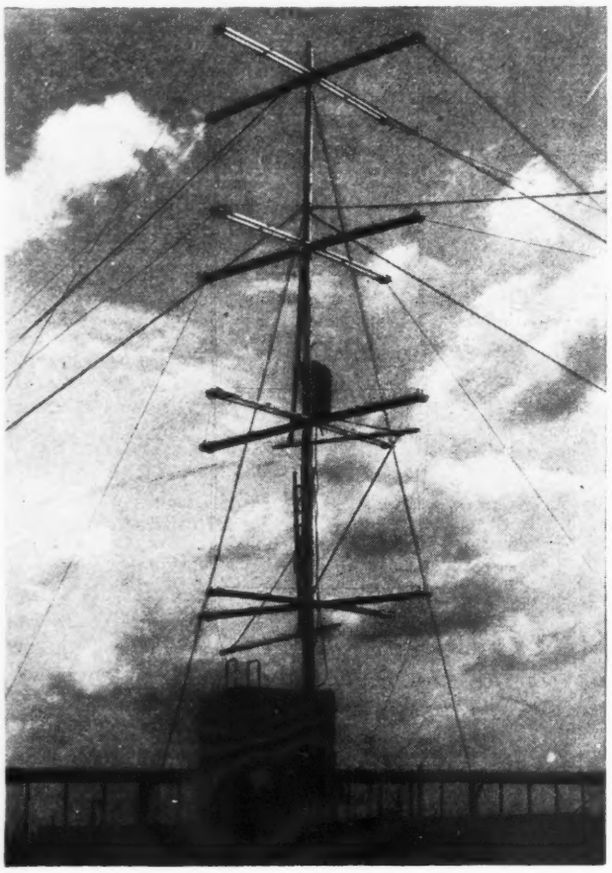
AND this issue of RADIO NEWS gives you the data on how to get started in this field and how to get successful results, too! Besides that, each consecutive issue of the magazine gives you technical data on receivers and transmitters for the ultra-short waves below ten meters.

* * *

PRINTED on this page is a reproduction of a photograph of the largest ultra-short-wave transmitter in the world, located in Berlin. The unusual form of the antenna for this station is located on the roof of the Europa building. The transmitter works at a wavelength of seven meters and it is intended for broadcast transmission on the ultra-short waves as well as for the introduction of television.

* * *

OTHER interesting and instructive articles appearing within the pages of this magazine this month are the following: "Music from Electrons," showing how Professor Theremin uses vacuum tubes and associate apparatus in a unique way to produce entirely new musical instruments. Experimenters will be interested in the article on "Making a Head Amplifier" for the condenser microphone already described. Then there are articles on "Radio's Evolution," a hearing device to help the deaf in the theatre, a new noise-measuring meter which should be valuable to scientists, an article containing information regarding installation of automobile radio sets, a new portable receiver, and an article on the uses of radio by a great city.



* * *

THESE are exclusive of the helpful material to be found in the departments, including "Radio Science Abstracts," which contains a new feature; "Latest Radio Patents," "With the Experimenters" and a new department for radio operaters which will be called "QRD."

* * *

COMING over the Editor's desk are an increasing number of letters from our readers that warm the cockles of our respective editorial hearts. Here are some excerpts:

* * *

"I HAVE taken your magazine for years and would just as soon miss a meal as one of the issues of RADIO NEWS. And the magazine is getting better every month. I especially like the two departments, the 'Service Bench' and 'With the Experimenters.'"

DENNIS E. WATSON,
Radiotrician Graduate of R.C.A.,
Fenton, Mich.

* * *

"I WANT to express my appreciation of the very fine articles on 'Radio Fever,' 'Radio Surgery' and the new articles, 'Radio Guards the Baby' and the article on germ life, 'Sounds That Microbes Make.' As a medical student, as well as radio enthusiast, I find them highly instructive and unusully interesting."

ISADOR BERNSTEIN,
Brooklyn, N. Y.

* * *

"I AM a serviceman, and of course the first thing I look for in your magazine is the 'Service Bench.' I have picked up much valuable information from this department."

WALTER A. BECKMAN,
Philadelphia, Pa.

* * *

"I HAVE only been a reader of your valuable magazine since January, this year, but I am very pleased with it. I had it recommended to me by the staff of Majestic Distributors, Ltd., as I merchandise these well-known sets."

W. Y. SHAW,
No. Huddersfield, England.

* * *

"I AM a regular reader of RADIO NEWS, and really think it is the best magazine the radio amateur can buy."

FRED XANDER, Lehighton, Pa.

* * *

"I AM a subscriber to RADIO NEWS, and believe it to be the best radio magazine published. I read it from cover to cover."

S. L. STANBROUGH, Kansas City, Mo.

* * *

"RADIO NEWS is increasingly interesting with the progress of time. You must be responsible for a tremendous increase of knowledge in radio science by your recent articles on 'Mathematics in Radio,' 'Graphs and Charts,' 'Electric Filter Design,' 'Radio Physics Course,' etc. You are giving us something worth reading and invaluable to your readers."

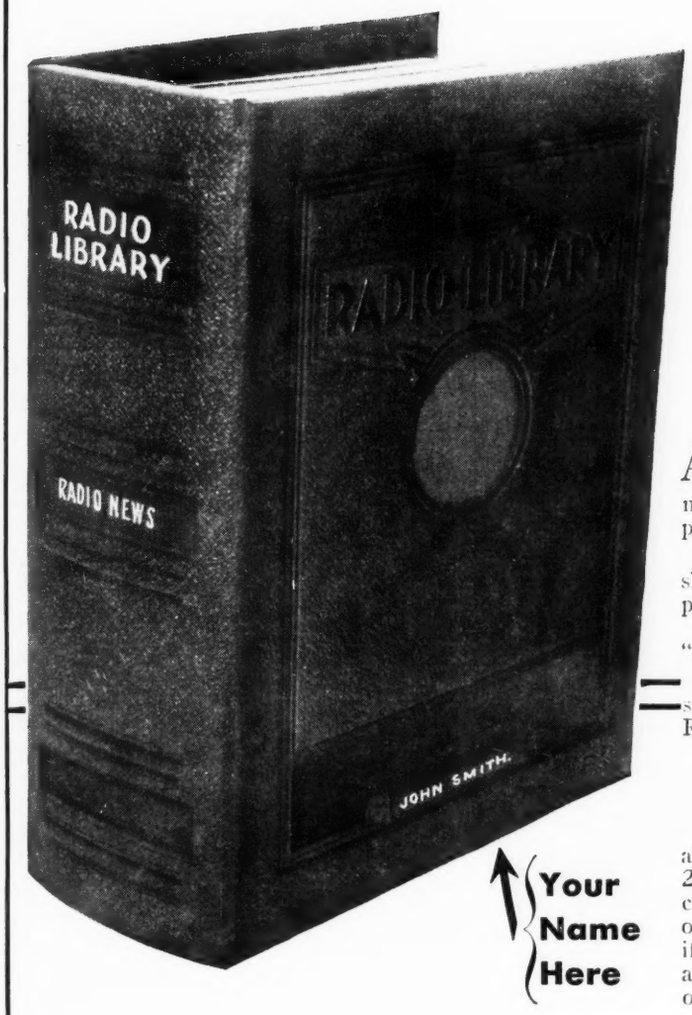
C. H. DAY,
Las Flores, Argentine Republic.

* * *

AND what more can the Editors ask as full payment for their efforts?

Stanwell McCready

File Your Copies of RADIO NEWS



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It is a binder which you will be proud to add to your "Radio Library" shelves.

For a limited time, we are offering one of these handsome binders FREE with a 2-year subscription for RADIO NEWS.

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But that is not all—In addition to securing this binder absolutely free of charge, you also save $2.00 on your 2-year subscription. 24 copies of RADIO NEWS purchased on the news-stands would cost you $6.00, but by our special offer you pay only $4, saving $2.00. Even if you were to purchase 2 separate annual subscriptions at the regular price of $2.50 you would still save money on this offer.

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Only a few seconds are required to insert each new issue of RADIO NEWS into this binder, as it is delivered to you each month by the postman. And, once filed, copies will not become mislaid or soiled. Your file is always available for instant easy reference. The binder is so constructed as to permit your copies to lay open flat, making easy reading. All pages are fully visible.

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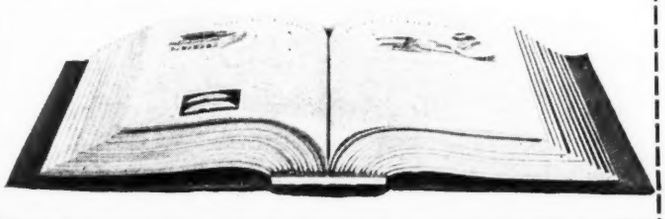
Supply Limited—Order Promptly

Our supply of these binders is limited, therefore we suggest that you send us your order promptly. This offer is open for either new or renewal subscriptions. Use the order blank attached today!



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Enclosed is $4 to cover the entire cost of my 2-year subscription for RADIO NEWS magazine. I understand I am to receive one of your 24-copy "Radio Library" binders FREE of charge.

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Address.....

City.....State.....

This is a new subscription—begin with issue dated .....
(If renewal subscription, check here .....)

I want my name embossed on the front cover, and am enclosing 25c to cover the additional cost.

Foreign and Canadian Price, $6.00.

Modern Arm of the Law—Auto Radio

Newest and most effective police equipment in enabling the forces of law and order to place criminals "on the spot" themselves, is found in the automobile radio installations already doled out to 250 motor-patrol cruisers in New York City. What good are guns or strong arms after the criminal escapes? The new radio equipment brings the police officers to the scene of the crime often while it is being committed.

Radio News

VOLUME XIV August, 1932 NUMBER 2

MUNICIPAL RADIO

How America's greatest city is using radio communication, not only in reaching its more than seven million citizens in their homes, but as the invisible ears of its police, fire-fighting, harbor-patrol and aviation forces—a medium of instant contact that is bound to increase the efficiency of these forces in protecting and preserving human life and property

By **Samuel Kaufman**

RADIO, long recognized as an invaluable police weapon in the war against crime, is also playing important rôles in many other phases of civic municipal government in a number of American cities.

Municipalities throughout the United States have studied the numerous public services rendered by radio and are spending millions of dollars for transmitters and receivers for various civic purposes. But no other city in the United States —or in the entire world—has sponsored so many types of radio utilities as has the City of New York.

The area of the greatest American city is 319 square miles. The officially estimated population of New York is 7,218,223. There are 5046 miles of streets laid out within the city's boundaries. Its total waterfront is 578 miles. The assessed valuation of taxable metropolitan real estate, including special franchises, is about $19,500,000,000.

These stupendous figures readily indicate the huge responsible tasks of city officials in protecting life and property. Radio, however, is making these tasks lighter and more efficient.

N. Y. Radio Forces

Today 250 radio-equipped motor-patrol cars cruise through the city's streets, constantly on the alert for alarms and instructions from Police Headquarters. Radio-equipped fire-boats steam through the nation's busiest harbor and its surrounding waters, protecting water craft and water-front property. A non-commercial broadcasting station is operated by the city. Radio is listed as a major subject in the municipal technical high schools with up-to-date equipment on hand for students' experiments. Numerous schoolrooms are equipped with receivers for educational broadcasts. Radio weather reports are invaluable aids to aviators leaving and arriving at the municipal airport.

The police radio system of New York is generally accepted as the most valuable of the civic radio services to public welfare. Since the system was officially launched last Winter, many achievements have been accredited to it. Costing $100,000, the New York police radio unit is by far the greatest police radio system in the world.

Three transmitters, located at strategic positions, contact 250 police automobiles in the five boroughs of New York. It is planned to virtually double this total of radio-equipped motor cars.

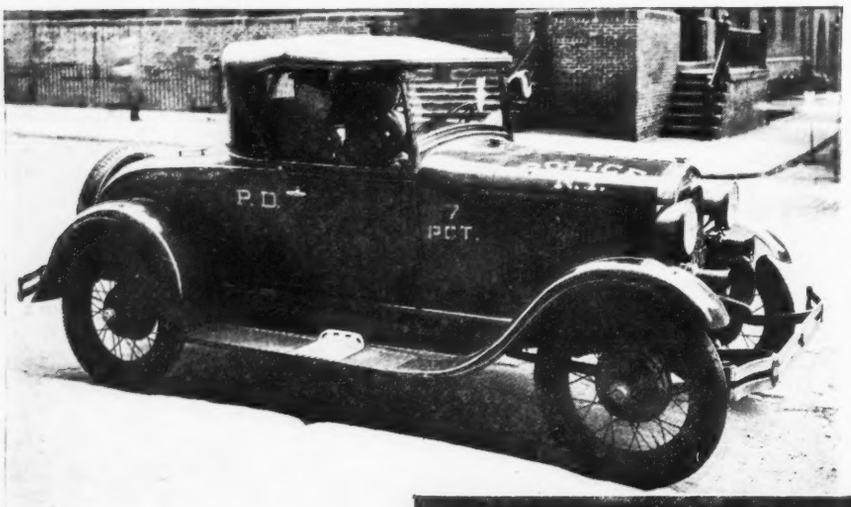
The receivers are 7-tube superheterodyne sets which are pre-tuned and locked to the police short-wave channel. The sets can only be adjusted in the police repair shops, no policeman being permitted to tamper with the set in the cars. Volume and sensitivity controls are mounted on the steering-wheel shafts of the police cars. Usually the set and loudspeaker are placed under the dashboard. In some of the small runabouts the radio chassis is placed in the rear utility compartment. In some of the limousine cruisers the loudspeakers are mounted in the roof of the car above an open grille.

THE VOICE OF NEW YORK

One of the city's trucks which can be set up to receive broadcasting from the municipal station when important political or civic events are to be held

Headquarters Unit

The main transmitter, a 500-watt unit, is located at Police Headquarters, where all of the police alarms originate. The entire headquarters radio unit is located in a circular room atop the building. Two auxiliary stations, sharing the same wavelength, are situated in



READY AND WAITING

Radio-equipped police cars can now be seen parked at the curb waiting for a call that brings them often within two minutes directly to the scene of criminal activity while the crime is being committed, resulting in the apprehension of the guilty persons. At right, interior view of a police sedan, showing the officer receiving instructions as he patrols the city streets ready for any emergency that might arise within his beat

the Bronx and Brooklyn. The auxiliary stations, each on 400 watts of power, are operated by remote control by the police dispatcher at headquarters. The three stations are not synchronized but are used in direct rotation from the single headquarter's microphone for the same police alarms. The purpose of the triplicate alarm method is to assure covering the entire city as well as to penetrate certain locations where reception conditions might otherwise be unfavorable. The call letters of the Manhattan (headquarters), Bronx and Brooklyn transmitters are, respectively, WPEG, WPEF and WPEE.

The Dispatcher's Desk

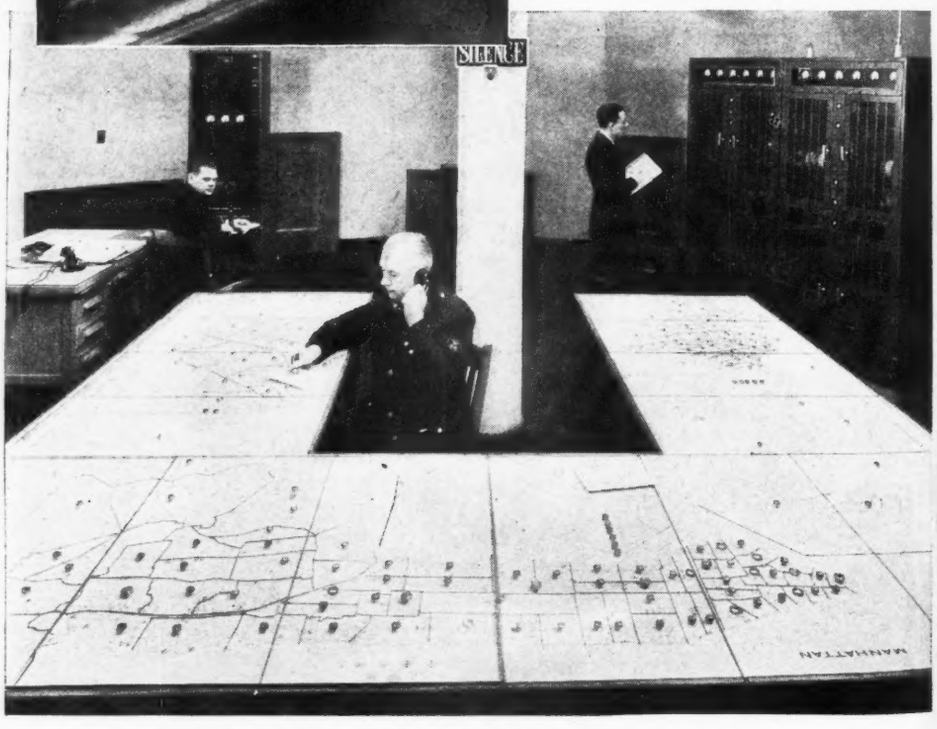
A large U-shaped chart table is used by the police dispatcher in the headquarters transmitter room. Under its glass top are large maps of the city's streets. The dispatcher and his assistants move brass markers to different positions on the charts to denote the location of every police radio car. The markers are numbered and bear insignia denoting the types of vehicle. The patrol cars range from two-man runabouts to seven-man limousines. When a radio set is reported out of commission, a brass ring is placed over the corresponding counter so that the dispatcher will not call that particular car but will hail the next nearest one in the event of an alarm in the district.

Before police signals went on the air, police officials were quite concerned over the possibility that the public would listen in to the alarms and hasten to the scenes of the reported crimes or disturbances. Through the uses of code phrases such as "Car 606! Proceed to 1401 Astoria Boulevard. Code 30," the specified car will hasten to the designated spot with the knowledge that a certain type of felony or misdemeanor was committed. Thus all dramatic phraseology is tabooed and replaced with formal police orders that can be interpreted by the policemen alone. Although the addresses are mentioned on the air, no crowds at the respective locations were attributed to the radio alarms.

Upon launching the radio system, Police Commissioner Edward P. Mulrooney stated: "Through the medium of this system it will be possible to immediately transmit to the patrol cars orders and direction to repair to scenes of crimes or disturbances. A full measure of service cannot be derived from this system, however, without the co-operation of the public, and all citizens are requested that when their attention is directed to occurances such as hold-ups, burglaries, crimes of violence, catastrophes and dangerous or unusual conditions, they immediately telephone to the Police Department and, if at all possible, to transmit description or license number of automobiles concerned. Such information will greatly facilitate the dispatching of scout and patrol cars to the scene of crime or disturbance."

The First Alarm

Just a few minutes after the Mayor and Police Commissioner launched the radio system, the first alarm went on the air. An average



POLICE RADIO DISPATCHER AND CONTROL BOARD

The control officer sits at a U-shaped desk-map of the municipal area, on which he records the exact position of all radio-equipped patrol cars

of 125 calls each day went over the trio of stations. This daily total included general departmental orders and experimental broadcasts as well as actual alarms.

Among the typical radio alarm accomplishments listed by Superintendent of Police Telegraph William Allan in a report to the Police Commissioner are the following:

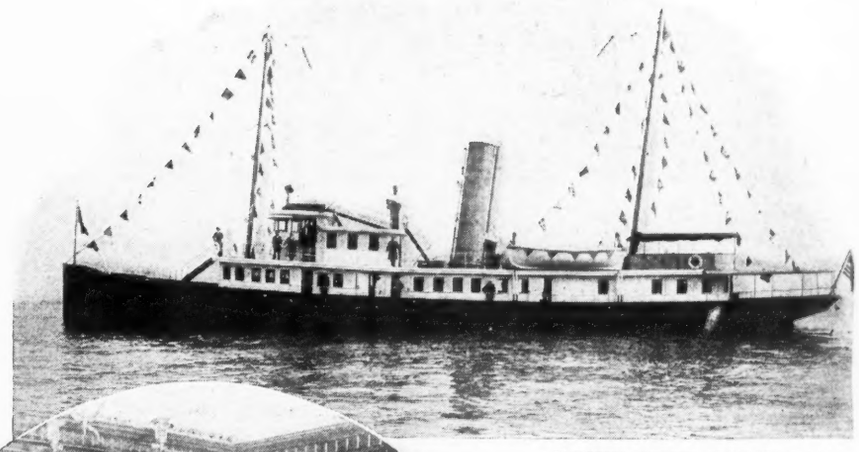
March 30, 1932—12:54 p.m. RMP 1019 and CRMPS 190 to 363 Edgecombe Avenue near 150th Street, 3rd floor rear. Burglars in apartment. Signal 30 —1:15 p.m. CRMPS reported they had arrested two negroes for burglary as a result of this call by radio. (Det. Di Martini, CRMPS 190, 6th Detective District.)

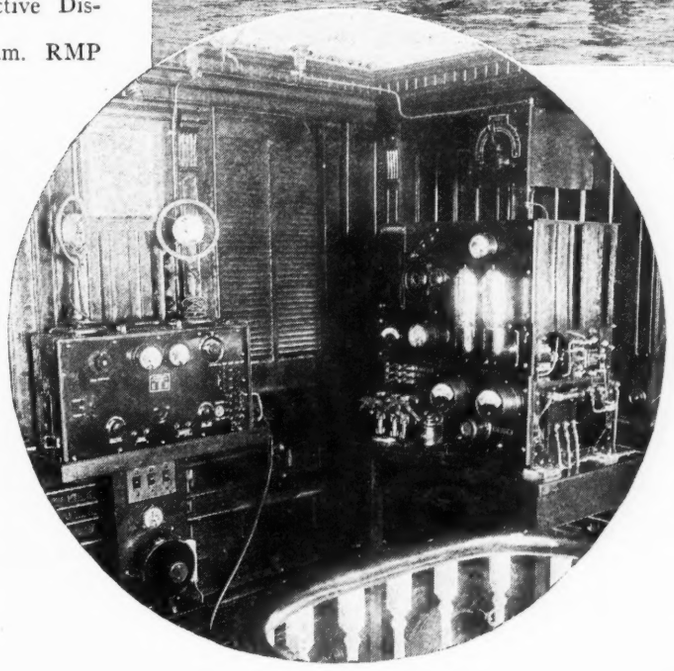
"March 30, 1932—6:08 p.m. RMP 501-642 and CRMPS 211 to Chambers Street and West Broadway I.R.T. subway station, Manhattan. Signal 30. —Authority: T. B. Operator 70. Report: Passing counterfeit money. — 6:22 p.m. Car 501 first on scene and arrested defendant, who had presented a five-dollar counterfeit bill. Car 602 on scene and ordered to resume patrol."

Quick Action

Thus throughout the first few weeks of the police radio's use, many attempted felonies and disturbances were thwarted and quelled by quick motor patrol response to the broadcast alarms. Frequently but a few minutes would elapse between the broadcast and the actual report of the arrest.

In addition to the automobile radio system, the New York Police Department is continuing its use of its long-established Station WPY for harbor communication. This, too, operates on short waves. The station uses code for contacting incoming ships and has often been effective in quelling mutinies or other disorders aboard ships in New York waters.

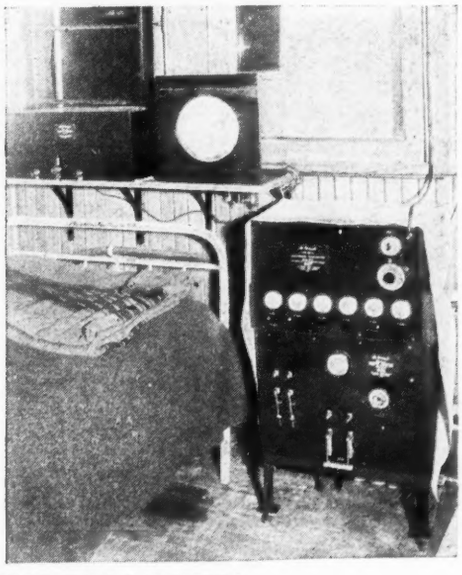




DOWN NEW YORK BAY

The patrol and "welcome" ship Macom *and its efficient radio transmitting and receiving equipment is always in direct contact with the municipal administrative offices. The* Macom *meets incoming ships bringing celebrities who are to be accorded special receptions by the city authorities*

The New York Fire Department has conducted numerous radio telephone tests for two-way communication between fire-boats and headquarters. Sets are installed on fire-boats, and satisfactory results have been reported. At this writing two fire-boat radio systems are licensed by the Federal Radio Commission. Station WCF at South Ferry is licensed for communication with Station WRBE aboard the fire-boat *John Purroy Mitchell,* and Station WRDU, at Brooklyn Fire Department Headquarters, contacts Station KGQT aboard the fire-boat *William J. Gaynor.* The fire-boat radio systems provide for the transmission of alarms and instructions to the floating engines as they steam through the harbor. Heretofore the boats often had to return to their berths before receiving instructions to proceed to a fire near a point they had already passed.



RADIO AIDS OUR HARBOR FIRE-FIGHTERS

Left, Valentine Fenrich, chief of New York Fire Alarm Telegraph Bureau, seated at the microphone at fire headquarters in Brooklyn. At right is the radio installation on the fire-boat Gaynor, *showing both the receiving and transmitting units*

High School Radio

The Brooklyn Technical High School, which offers a course in radio mechanics and operation, takes pride in a standard 1000-watt transmitter for experimental purposes. The set, a professional broadcasting unit, is a duplicate of the transmitter used by WNYC, the municipal broadcasting station. It operates on a "phantom" antenna which confines the transmissions to the school structure and no federal license is regarded as necessary for this method.

Although WNYC possesses a 1000-watt transmitter, it can only use half that power for its broadcasts under its license. It is operated by the Department of Plant (*Continued on page* 118)

HOW MODERN PHYSICISTS ARE USING

Music from

The work of Theremin in producing the hand has created a sensation in the developed on improved principles are cians alike new and original fields of describes these systems in detail

IT PLAYS LIKE A CELLO—

Figure 9. But it isn't one. It is the latest Theremin fingerboard instrument, in which the sounds are issued from a loudspeaker

A COMPLETE orchestra, consisting exclusively of instruments employing radio principles, was played recently in Carnegie Hall in New York City.

Many who attended this demonstration, using exclusively instruments designed and developed by Professor Leon Ssergejewitsch Theremin, young Russian inventor of wireless music, felt that they had seen the launching of the instrumentation of tomorrow; of an era of richer means for the expression of artistic feelings and interpretations—not handicapped by the physical means of range and threshold of standard instruments. In the line of the various instruments this may mark the first fundamentally new musical development for the last 100 years. It is a beginning of the use of the possibilities which dreamers and scientists attach to music, and with some minor imperfections which show that we are just at the *start* of a new musical development.

What is this new ether music we hear so much about? How is it made, how is it controlled, how is the sound impression that reaches our ears and finally influences us emotionally produced?

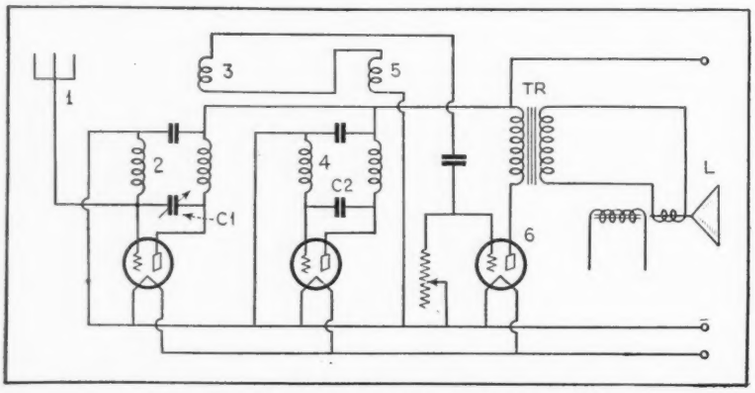
For a better understanding of this apparatus, let us go back to some phenomena that we are all familiar with. Do you remember the early days of radio, when the receivers started a long-drawn howl if you approached them? When the set was perfectly tuned (so long as your hand was near the panel), but the adjustment was disturbed as soon as the hand was taken from the dial? Do you remember the apparatus started oscillating in various tunes and pitches until it was learned how to properly shield it? At that time you had witnessed the beginning of ether music. A nuisance to most of us, these disturbing sounds are now being harnessed by Theremin.

By Irving J.

Theremin drew out that howl into the length of several octaves, subdivided it into various pitches, controlled its intensity, its timbre and sound pattern and thus produced the wide range of various types of tones available today in his newest instruments. He made the apparatus for covering, continuously, the entire musical scale—not only the preferred spaces as they occur incidentally and undesirably—and further made it possible to subdivide this scale and to control it.

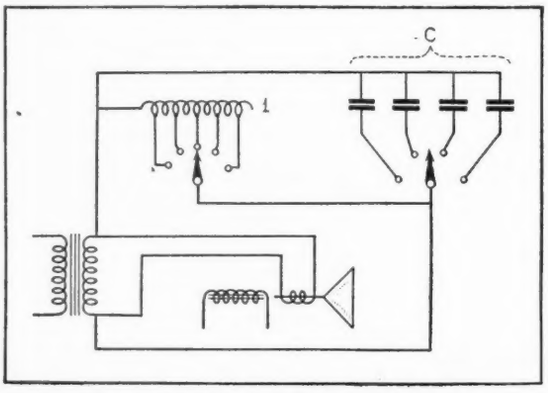
The first instrument that was brought before the public notice some years ago was the space-controlled instrument. Figure 1 shows its appearance in its present form. Professor Theremin stands before his instrument, his right hand near a vertical antenna post, his left hand over a nickel-plated "ring." The nearer the right hand approaches the vertical rod, the higher is the pitch of the sound produced. If the right hand is moved back, the distance of the air-layer between the rod and the right hand is increased and the pitch of the sound gets lower and lower; the frequency of the sound decreases.

The left hand controls the volume. If it touches the ring,



CIRCUIT SHOWING DOUBLE OSCILLATOR

Figure 2. Here is the wiring diagram for the musical oscillator system which controls the pitch of the sounds produced



CIRCUIT FOR "TIMBRE" CONTROL

Figure 3. Diagram of the oscillating circuits used to control the quality of the sound produced

VACUUM TUBES TO EXTRACT UNIQUE

Electrons

controllable musical tones by waves of musical world, and his latest instruments, opening up to the composer and musi- creation and technique. The author from an electrical standpoint

Saxl, Ph.D.

INVENTOR AND EARLY INSTRUMENT

Figure 1. Professor Theremin, although in this picture seemingly conducting an orchestra, is in reality playing one of his space control musical instruments by waving his hands near the rod and metal ring

no sound is heard; if it is raised, the volume is small; if the distance is increased, the volume increases.

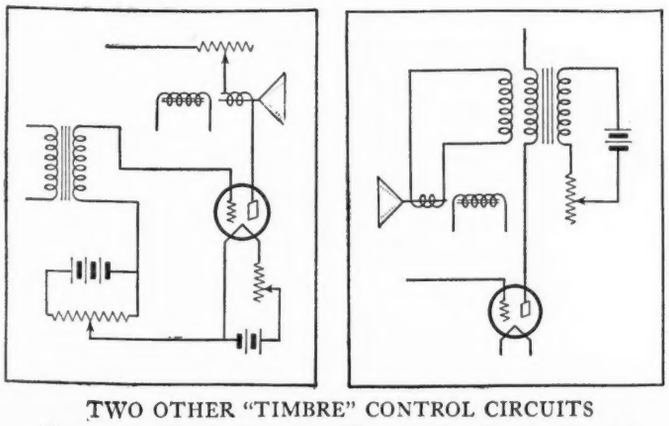
With the right hand controlling pitch and the left hand controlling volume, a variation of numerous tones is thus made possible. How is this change in pitch and volume produced electrically? Figure 2 shows a schematic wiring diagram of the fundamental electrical circuit for the production of a single tone of variable pitch. We see two independent oscillating circuits, 2 and 4, which are almost alike as far as their electrical constants are concerned. The actual frequency of the two oscillators is about the order of 500,000 cycles; that means high above the range of audibility. The precise frequency is so chosen that no interference with radio broadcasting is produced.

Slight changes in the frequencies of one of the two oscillators will therefore produce sound by interference. If one of the circuits is only slightly detuned, for instance, so that it has only 499,565 oscillations instead of the original 500,000, then the difference will be 500,000—499,565=435 cycles.

This, however, is the tone of the pitch A. As seen by these two numbers, only a very slight detuning from the natural frequency of one of the original frequencies is necessary, in our case *less than one-tenth of one percent*, for the production of an audible note. If higher frequencies, especially those of the short-wave range, are used for the production of the superimposed frequency, the frequency distortion of one of the original circuits will be fractions of this value.

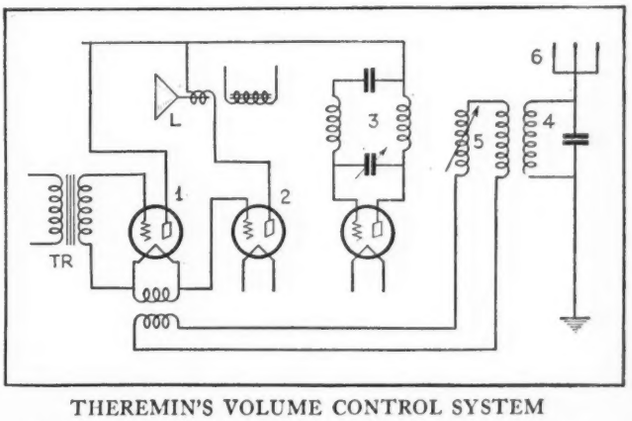
The two oscillating circuits are controlled by a fixed condenser, C2, and a variable condenser, C1. The latter is tuned so that both circuits oscillate at the same frequency and no sound is produced by superimposing one to the other. Then only a slight detuning of one of the circuits, in the dimension of 10^{-8} mfds., is sufficient for producing sound. This is extremely small and can be easily effected by a tiny change of the capacity of the control electrode 1. This sensitivity is so high that it is possible, as mentioned in the last issue of RADIO NEWS in the article, "Radio Guards the Baby," to record changes in the field surrounding the apparatus for a distance of 20 feet. This control is primarily the result of changes in the electrostatic capacity between the control element and other elements of the circuit. If the operator's hand, fingers or any other object which is grounded or otherwise able to influence the properties of the dielectric field surrounding the antenna 1 is moved with reference to the latter, a change of the fundamental frequency in the oscillator 2 will occur. As the operator's finger are moved in suitable relationship with this control element, the pitch of the beat note produced by the superimposing of the two different frequencies of oscillators 2 and 4 is varied accordingly. These two slightly different frequencies are brought together through the coupling coils 3 and 5 and fed into the tube 6, wherein they are amplified and put through the audio transformer TR to the loudspeaker L.

This system, as mentioned above, produces sounds of practically sinusoidal characteristic. The unmodulated tone



TWO OTHER "TIMBRE" CONTROL CIRCUITS

Figure 4. Circuit for controlling quality by varying tube characteristics. Figure 5, Center: Control of quality by varying iron-core characteristics



THEREMIN'S VOLUME CONTROL SYSTEM

Figure 6. Circuit by which the volume of the space control music may be varied from maximum sound to zero by a mere wave of the hand near the metal ring

sounds, therefore, somewhat similar to a wood-wind instrument—for instance, a flute. While this characteristic is a desirable one for physical experiments where we deal with cleanly identified sound waves, we prefer in music today a somewhat warmer tone. It is the harmonic distortion from the purely physical form that gives life to a sound. This variation of the frequency characteristic can be analyzed, following Fourrier's formula, as a number of separate sounds of sinusoidal characteristic which are superimposed on the basic tone. These beat notes, following a statement of Helmholtz, are characteristic for the individual instruments, making a violin, for instance, sounds differently from a flute, although both may be playing the same note. It is the adding of these distortional factors that gives individuality to the instruments.

Producing Vibrato Effects

Comparing the human voice and the violin, there is one common factor: the pitch is not held absolutely constant. There are always slight variations, a vibrato which can be great enough to be felt as such. But even if this effect does not appear consciously, these minute variations give these types of sound a certain warmth. For producing this effect on the Theremin instruments, the fingers of the right hand that control the pitch are in a constant trembling motion. That means, electrically speaking, that the capacity between the grounded body and the antenna 1 undergoes rhythmical changes as the distance between the vibrating hand and the metallic conductor (comparable to the two layers of a dielectric) varies. The sound will therefore not stay rigidly on one single pitch, but vibrate slightly around it.

In addition, by special electrical circuits, a predetermined "distortion" of the sound wave can be arranged. It is possible, for instance, to put into the output one or more resonating circuits, increasing or absorbing certain frequencies.

Figure 3 shows a schematic diagram for a circuit to accomplish this result. Many others are possible. A number of capacitances C and an inductance with several taps may be connected in parallel to the loudspeaker. According to their position, special frequencies and overtones of the reproducing instrument can be enhanced, others suppressed, etc.

Another means for varying the timbre of the purely sinusoidal reproduction is the variation of the quantitative composition of the overtones by means of deforming the primary alternating current or by working on the curved parts of the amplifier characteristics instead of using the straight-line amplification ordinarily desired. This can be done in various ways; for instance, in circuits as shown in Figures 4 and 5. The desired part of the working characteristic of the tube amplifier can be selected by varying the voltage of the grid bias as shown in Figure 4.

In Figure 5 means are shown for influencing the magnetic characteristic of the iron core in the audio transformer or in the loudspeaker. A static magnetic field is impressed upon the magnetizable material. Thus it is made possible to have the actual transformation of the oscillations performed on an end point of the hysteresis curve instead of on the straight-line part, so that a "distortion" is created purposely.

These are, of course, only a few of the means that can be used. In the actual construction there are a number of additional possibilities for the selection of timbre and the graduation of the adjustment.

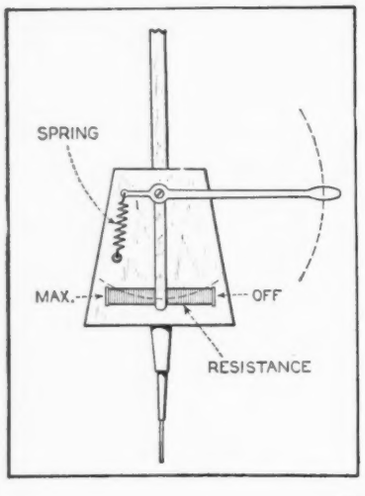
There remains for discussion the means for the control of the volume of the sound. I saw, as early as 1929, two of the original Theremin models of the space-control instruments in which the control of the sound volume was done with a carbon-pressure resistance. A carbon resistance was put parallel to the loudspeaker or used as a variable resistance for the filament current.

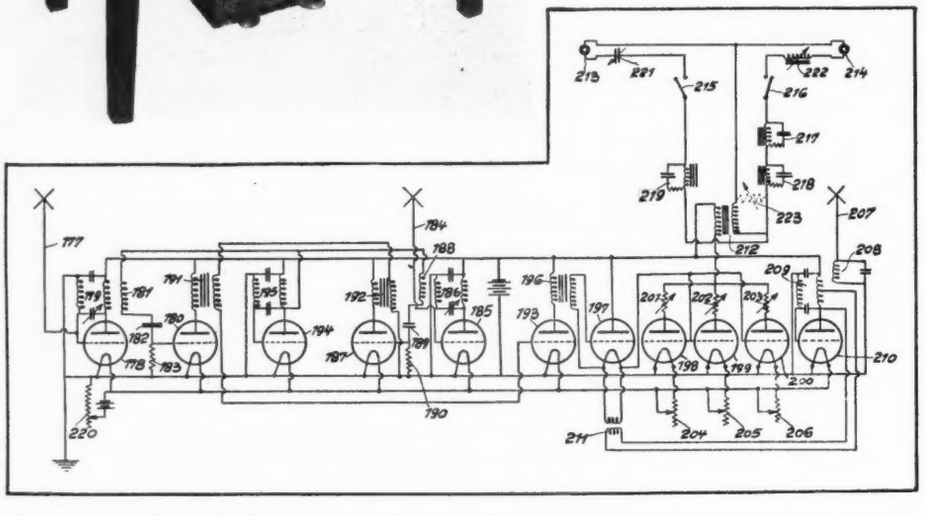
In Figure 6 is shown the schematic diagram of the modification employed in the volume control of Theremin's space-controlled instrument. In this set-up the cathode current of an amplifying tube 1 connected to the audio transformer TR, is regulated inductively from the high-frequency circuit of the tube 3 in the amplifier. This system utilizes the fact that the circuit 4, which is almost in tune with the oscillator 3, will absorb more or less energy of this circuit, as determined by the degree of its resonance with the circuit 5. Maximum energy will be generated when the control circuit and the oscillator circuit are in resonance, a small amount of energy will be generated if they are not in tune. Slight changes in the capacity of the antenna rod 6 will therefore vary the resonance of the circuit 4 and thus influence markedly the heater current in tube 1 and finally the volume output of the loudspeaker L.

This system is connected to the "ring" (*Continued on page* 120)

A PIANO—OR NOT A PIANO?

Figure 8. No—this instrument contains no strings or striking hammers. It is a tube-controlled keyboard instrument which produces sustained tones unlike any other ones the human ear has ever heard





TWO OF THEREMIN'S BASICAL MUSICAL INVENTIONS

Figure 7. At left shows the method by means of which the fingerboard instrument shown in the photograph in Figure 9 is controlled for volume of sound produced. Figure 10, Right: This is Theremin's basic circuit reprinted from the American Letters Patent, showing the hookup of the various vacuum tubes used in the space control instrument

THIRTY-ONE NATIONS VISIT COPENHAGEN FOR SECOND MEETING OF THE C. C. I. R.†

By Gerald C. Gross*

SINCE radio by its very nature is universal, its waves or emissions transcending the bounds of city, county, state, and even national frontiers, it is evident that occasional meetings at which the radio-using nations of the world may gather and discuss the major aspects of radio are frequently necessary. Thus both the national and international aspects of these conferences are seen.

In 1903 the first international radio conference was held in Berlin as the result of the efforts of President Hoover, who even then foresaw some of the world-wide problems involved in the inevitable growth of this new-born and precocious child of science.

The international agreement adopted by the conference at Berlin in 1906 (a preliminary conference was held in Berlin August 4 to August 14, 1903, but final action was taken by the conference held in Berlin from October 22 to November 3, 1906), was known as the International Wireless Telegraph Convention of Berlin, and was in force until superseded by the London Convention of 1912, a document carrying the same title as its predecessor, and of course was much more detailed in the scope of its technical regulations than the one which it replaced. Many changes had taken place and new uses were developing.

During the period of the World War, except for occasional meetings among the allies to consider radio, no further conferences were held for a period of fifteen years. But in 1927 the Washington Radio Conference took place. Inasmuch as this was the first conference held after the World War, and since most of the rapid progress in radio during that time was brought about by the wide use of radio for fast and continuous service during the seething activities of the war, it became necessary to provide entirely new regulations taking into account new developments in the art. As a result the Washington Convention, and the General Regulations attached thereto, became the most comprehensive document covering international radio communications ever established.

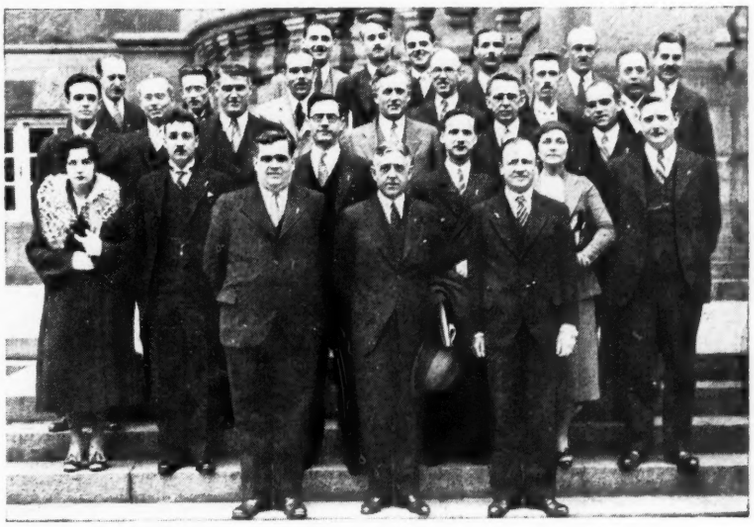
Among other things, the Washington Convention provided for the holding of major international radio conferences of a regulatory nature every five years.

The first of these technical conferences, known officially as the International Technical Consulting Committee on Radio Communication (commonly called the C. C. I. R., in accordance with the French wording, Comité Consultatif International Technique des Communications Radioélectriques), was held at The Hague in September, 1929. The United States was represented by a delegation comprising nine government representatives, headed by Major-General C. McK. Saltzman, chairman of the Federal Radio Commission. In addition to the government delegation there were present sixteen representatives from the communication companies of the United States. The report of this meeting, covering the material submitted and the work accomplished, was published by the Government Printing Office and is available for sale by the Superintendent of Documents, Washington, D. C., Publication No. 105.

The preparatory work for international radio conferences involves many ramifications which are not known to the casual follower of radio. In the United States the preparatory work for both meetings of the C. C. I. R. was organized under the direction of the Federal Radio Commission at the request of the Department of State.

The Conference at The Hague accepted the invitation of Denmark to hold its next meeting there two years later.

The second meeting of the C. C. I. R. was held in Copenhagen, Denmark, from May 27 to June 8, 1931. This conference was attended by delegates of some 31 nations. The United States was represented by a delegation of eleven, headed by the Honorable Wallace H. White, Jr., United States Senator from Maine and for several years a leader in Congressional radio matters



AMERICAN RADIO DELEGATION TO COPENHAGEN

United States conferees on the steps of the Christiansborg Palace. Front row: Dr. C. B. Jolliffe, Senator White, Dr. J. H. Dellinger. Second row: Miss Carter, Messrs. Gerald C. Gross, Irvin Stewart, Lloyd Briggs, Miss Howell. Third row: Messrs. Chapin, Dumont, Lt. Commander Redman, Dr. Wilson, Lt. Commander Webster, Mr. Buttner. Fourth row: Messrs. Gallant, Lebel, Lt. Maddocks, Mr. Whittemore, Major K. B. Warner, Mr. Espenschied. Last row: Messrs. Turkal, McIlwrath, Charbonnel, Pratt. Lt. Guest, Mr. Goldsborough

The Copenhagen Conference adopted a total of 21 opinions, which, when added to the 29 opinions adopted at The Hague Conference, makes a total of 50 technical opinions expressed by the C. C. I. R. in its first two meetings. Some of these opinions were of course limited in scope, having to do with the methods of organization of the meetings of the committee, preparation of proposals for the conference, procedure to be followed in forwarding reports on questions under study, etc. Opinions Nos. 30, 31, 32 and 33 fall under this heading. The opinions which were finally adopted by the unanimous agreement of the conference are as follows:

OPINION No. 30: Time limit for sending proposals for the meetings of the C. C. I. R.

OPINION NO. 31: Forwarding of proposals concerning unsolved and new questions.

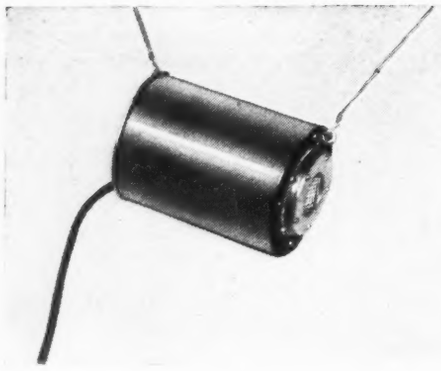
OPINION No. 32: Normal procedure for forwarding reports on questions to be studied.

OPINION No. 33: Proposals of (*Continued on page* 128)

*Chief, International Relations Section, Federal Radio Commission.

†C. C. I. R., Comité Consultatif International Technique des Communications Radioélectriques.

HOW TO BUILD A HEAD AMPLIFIER FOR THE



CONDENSER MICROPHONE

By George A. Argabrite

THE most rigid requirements of any audio amplifier, from a quality standpoint, are, perhaps, those demanded from the audio channel immediately succeeding the condenser microphone, commonly called the "head amplifier." Practice has proven that resistance-coupled amplification is the most worthy method of producing the gain from the relatively weak response of the electrostatic microphone.

Fortunately, resistance coupling requires a minimum of space and also a minimum of cost. The space factor is an important item, because it has been found that the only satisfactory set-up in this form of amplification is to include the head amplifier and microphone in the same shielding container, or at least within a few inches of each other. If the microphone were at all removed from the head amplifier, the weak microphone currents would be lost.

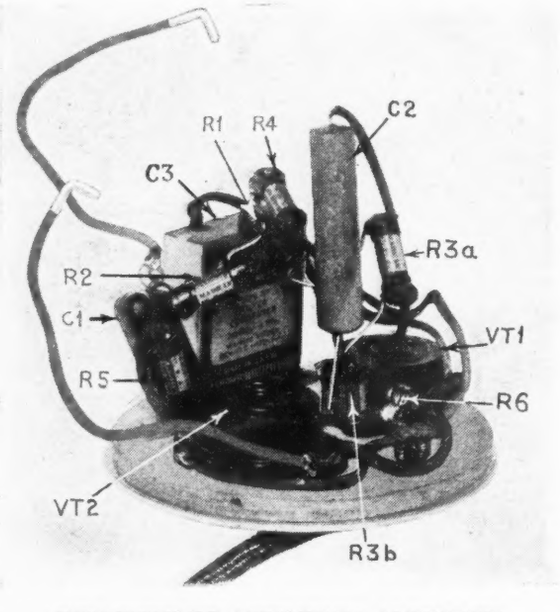
It has been the custom in the past to use only the more expensive wire-wound resistors in the plate leads of these amplifiers. However, considerable experimentation has proven that, with judicious selection, carbon resistors of good quality may be used in place of the more costly wire-wound type.

Resistance Coupled

Moisture seems to be the most evident cause of noisiness in carbon resistors. By using resistors which have been thoroughly treated against moisture, as is the case of the carbon resistors specified in this article, this trouble can be avoided. In purchasing the resistors of lower values it is advisable to check them by means of an ohmmeter. This insures the proper plate current on the tubes. Any unit that reads considerably higher than the rated value should be discarded, as such a defect indicates poor contacts or a bruised and broken resistance element.

Various makes of condenser microphones vary in quality of reproduction, and inferior quality is oftentimes traced to certain frequency resonant points within the range of the instrument. The diaphragm is invariably stretched, and its resonant point is above that of the ordinary audio spectrum. But certain members of the instrument may have resonant points within the voice range. If such a point occurs near 100 cycles, which is at the lower end of the spectrum or around, say, 8000 cycles, which is the upper extreme, the difficulty may usually be eliminated by employing a proper value of coupling condenser, C1. The value of this condenser may range from .005 to .025, and the only proper method of determining the value is by the cut-and-try process. The larger value will, of course, pass the lows more effectively. All condensers shown pass audio current and block the direct. The values of C2 and C3 are not critical, but may be taken as indicated in the diagram.

The microphone itself does not draw current after its first instantaneous charge, so the 30 megohms (R1 and R2) allow practically the full 180-volt charge on the diaphragm. The resistor, R3, actually consists of two resistors in series, one of 100,000 ohms (R3a) and one of 10,000 ohms (R3b). R3b was originally installed as part of a resistance-capacity filter for this circuit. This filter was found unnecessary, and the condenser was taken out but the resistor left in place. It is not needed and may therefore be omitted by the constructor.



SIDE VIEW OF ASSEMBLED AMPLIFIER

The location of the parts is shown here. The exact placement of the resistors is not critical, but all leads should be kept as short as possible

Motor-boating in this amplifier may be effectively stopped by paralleling either one or both R3 and R4 with a .25 mfd. condenser. However, good stability has been demonstrated and such trouble need not be anticipated.

Two-Volt Tubes

The type –30 tubes shown in the circuit are highly practical, as they draw a minimum of plate as well as filament current. A pair of number 6 dry cells should supply the filaments of the two –30 tubes for 200 hours. The constructor may bear in mind that slight overloading of the filament of this tube greatly shortens its useful life. Two volts is normal and 2.2 volts is the permissible maximum. The three volts supplied by two dry cells should be dropped to two through a ballast resistor or rheostat. Or one cell of a

storage battery may be used without a series resistor.

The illustrations will provide rather complete details of the amplifier and shield construction. First select a can about 4½ inches in diameter by 6 inches in height. Cut off the top and cut a hole in the bottom just large enough to allow the microphone case to nest therein.

Next cut out a circular piece of wood to a diameter which permits it to fit snugly into the top of the can and ¼ inch or ⅜ inch in thickness. This will serve as the base for the amplifier. Then another round piece of wood, fiber or bakelite, is cut to fit within the turned-over edge of the bottom of the can. This piece should have a hole cut in its center the same size as the hole cut in the can bottom. The purpose of this is to reinforce the remaining tin of the bottom, thus producing a secure and neat mounting for the microphone. This insulating material is then attached to the tin by means of screws. Holes are drilled through both and threaded to take the screws used in attaching the microphone. It may be found necessary to cut away some of the tin to prevent the output connection of the microphone from coming in contact with the tin, thus short-circuiting the output.

Complete Shielding

Finally, cut a metal disc slightly larger in diameter than the can itself and attach it to the outer side of the amplifier base. One of the screws used to fasten these two discs together should be extended through the wood base and connected to the filament circuit of the amplifier to ground the metal disc. After the amplifier has been completed, the can is inverted over it and attached thereto by means of screws extending through the top edge of the can wall into the edge of the amplifier base. The can, with the microphone in its bottom and the metal disc over the top, provides complete shielding.

A five-wire cable of the required length is used for the battery and output leads. This is brought through a ⅜-inch hole drilled in the amplifier base. When the microphone amplifier is to be used near a transmitter, the cable may require shielding.

The instrument described above is the design of several identical units which have been in use for many months. Continued first-class performance may surely be expected from the well-constructed amplifier.

Parts List

R1—Aerovox type 1095 carbon resistor, 10 megohms, ½ watt.
R2—Aerovox type 1095 carbon resistor, 20 megohms, ½ watt.
R3a, R4—Aerovox type 1095 carbon resistors, 100,000 ohms, ½ watt.
R3b—Aerovox type 1095 carbon resistor, 10,000 ohms, ½ watt.
R5—Aerovox type 1095 carbon resistor, 3 megohms, ½ watt.
R6—Aerovox type 1095 carbon resistor, 2 megohms, ½ watt.
C1—Aerovox type 1460 mica condenser, .005 microfarads, molded bakelite.
C2—Aerovox type 281 cartridge condenser, .1 microfarad, 200 volts.
C3—Aerovox type 207 filter condenser, 1 microfarad, 200 volts.
VT1, VT2—Pilot type 216 four-prong subpanel sockets equipped with −30 type tubes.
1 five-wire battery cable of the required length.
1 shield can (see Figure 2.)

Laboratory Notes on the Condenser Microphone

(Originally Described in the April, 1932, Issue)

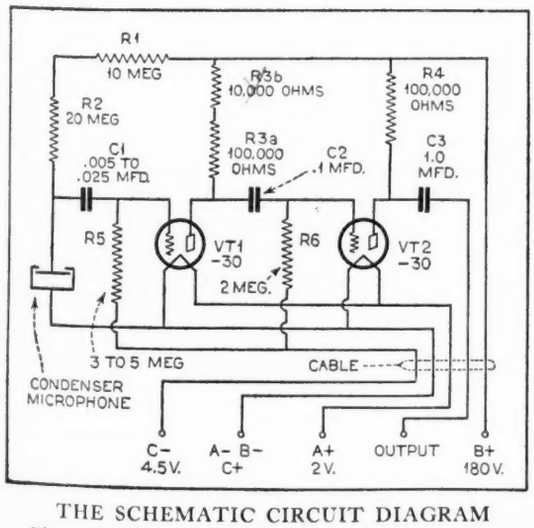
THE unprecedented interest shown by readers in the condenser microphone described by Mr. Argabrite, in the April, 1932, issue, unfortunately resulted in dealers' stocks of the Western Electric phonograph units being sold out almost overnight. It was only a matter of a few days after publication of the article that RADIO NEWS started receiving inquiries as to where these units could be obtained. Investigation disclosed that the Western Electric Company was no longer making them and had no surplus on hand. Nor could any other source of supply be found.

The many readers who were unable to build the microphone because of the lack of this unit will be interested in knowing that a New York manufacturer, the Chrisell Acoustic Laboratory, is now in a position to supply duplicates of the Western Electric unit. In fact, this new unit is superior to the old in that it is ready for use and does not require any machine work or changes of any kind. An over-sized hole is provided in the top plate of the unit and the wire screen is already installed. In other words, the case, as supplied by this manufacturer, is exactly like the one shown in the picture on page 848 of the April issue.

This same manufacturer can also supply the complete parts for the internal construction of the condenser microphone. These parts include the tube base, the perforated back plate and the diaphragm. Thus the experimenter can easily assemble the microphone with the simplest of tools.

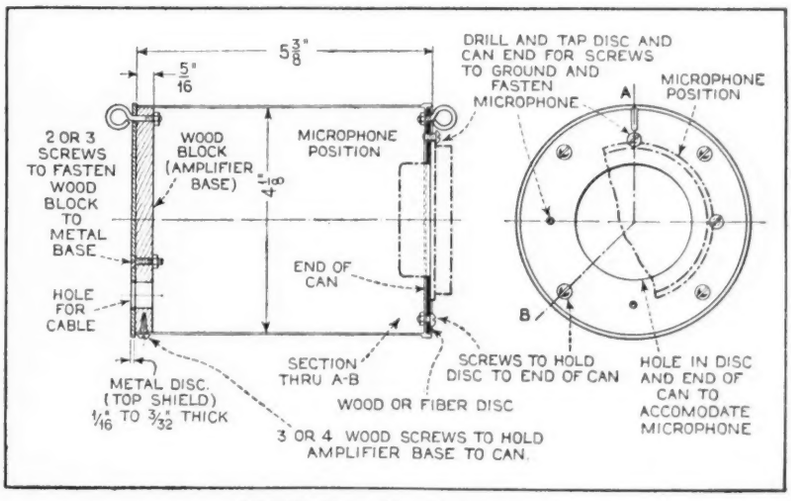
Since the article appeared in the April issue, the RADIO NEWS Laboratory has been conducting some further tests and experiments. While the preliminary tests on Mr. Argabrite's microphone showed it to be unusually good, a later test proved it to be even better than was at first thought. Comparisons with carbon microphones, ranging in cost all the way up to $100, were all extremely favorable to this little condenser microphone. Not one of the microphones with which it was compared were any better, and in fact there is some question as to whether the best of the lot was as good as this little home-made job.

In this experimental work it was found that the diaphragm made from the wrapping of a pack of "Old Golds" worked out very nicely. However, a diaphragm made of .001 inch duralumin (hard) was considerably better in so far as the frequency response (*Continued on page* 120)



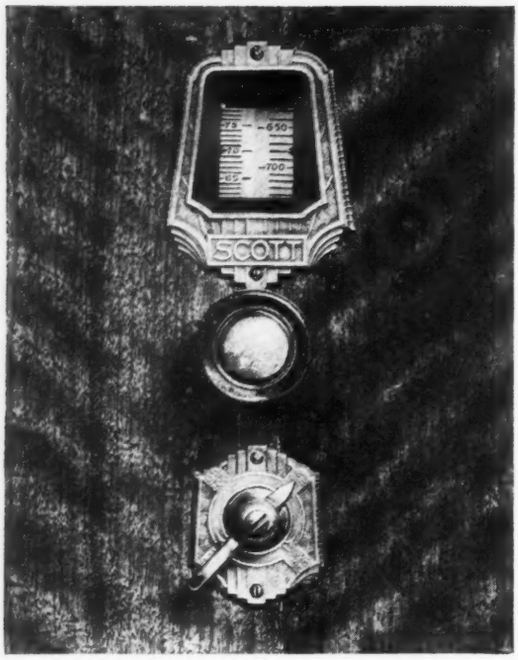
THE SCHEMATIC CIRCUIT DIAGRAM

Figure 1. The simplicity of this amplifier is quite evident from this diagram



SECTIONAL VIEW OF "CAN"

Figure 2. The complete shield is shown here with condenser head in place, but without the amplifier assembly



TUNING SIMPLIFIED TO THE UTMOST

All tuning is accomplished with the single knob, without trimmers or auxiliary controls of any kind. The lever below permits instantaneous selection of any one of the four wavelength bands

Dx fans!

"AROUND THE WORLD LATEST ALL

In Jules Verne's time 80 days was a ter of minutes, via radio, with the heterodyne described here, a receiver

Part

By S. G.

THIS new superheterodyne, just placed on the market, offers interesting evidence of what the engineering laboratory can produce when it is not hampered with the necessity for turning out a product to meet a price, and when it is not carried away with every new development that has been given wide publicity during the preceding year or two.

Working on the theory that attention to details in refinements and development to produce the utmost in tone quality, sensitivity, selectivity and simplicity of operation is what the public wants, the laboratory engineers went to work on this receiver, with the results which will be disclosed in this and the two succeeding articles of this series.

The new Scott de-luxe all-wave receiver covers the wave-bands from 15 to 550 meters without a break. It employs twelve tubes in all, nine of them being included in the tuner chassis and three in the power-amplifier, power-supply unit. The chassis of these two units are chromium plated. The receiver is separated into two units, to avoid the crowding that would be necessary were an attempt made to include the whole receiver on a single chassis.

The tuner includes one tuned r.f. stage, first and second detectors, oscillator, three i.f. stages and two audio-frequency stages. All of the operating power for these tubes is drawn from the power-amplifier unit, which also includes a pair of –45's in push-pull, serving as the power output stage.

Real "Single Control"

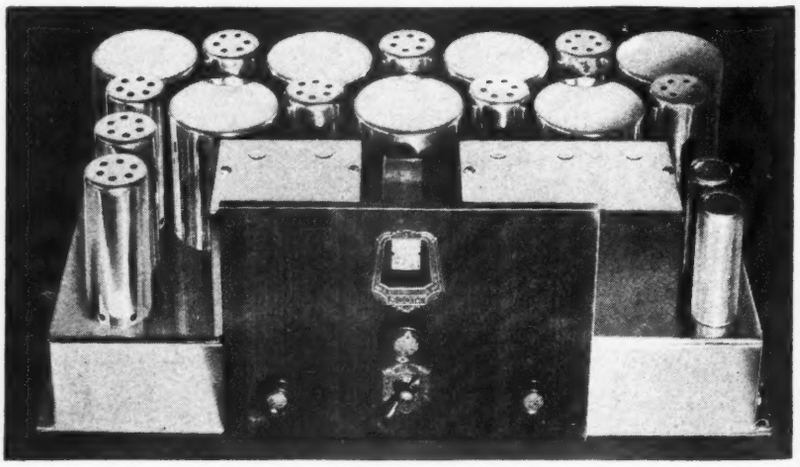
Tuning is accomplished by means of a single control, without trimmers or auxiliary controls of any kind to aid in tuning. The only other operating controls are the volume control and the local-distance switch, these two knobs being located on either side of the tuning-control knob. The power switch, instead of being included on the front panel, is on the end of a short extension cord and is of the long-neck, toggle type designed for mounting on the side of the cabinet in which the receiver is housed.

Outside of true single-control tuning, the outstanding feature is undoubtedly the highly perfected switching system which automatically provides all band-changing operations without resorting to the use of plug-in coils. The elimination of the plug-in inconvenience is not necessarily new. But to perform this feat by means of a switching system which provides just as high efficiency as could be obtained with plug-in coils is indeed an accomplishment worthy of note.

This entire switching system is controlled by a four-position switch lever on the front panel, just below the tuning-control knob. A movement of this lever permits the operator of the receiver to select any one of the four wave-bands—15-23 meters, 23-61 meters, 61-200 meters or 200-550 meters. So far as the other operating controls are concerned, their handling is identical on all wave-bands. It is therefore not a bit more difficult to tune in short-wave stations than to tune the regular broadcast band, except for the inherently sharper tuning of short-wave stations. This is one receiver, therefore, that can be tuned over any band by any member of the family, regardless of how little patience and mechanical or electrical ingenuity he or she may possess. So much for the general description of the receiver. (There will be more details later on its various technical features and on the reception results to be obtained on the short waves. The balance of this article will be devoted particularly to its operation as a broadcast receiver on the regular broadcast channel of 200 meters to 550 meters.—ED.)

Perhaps the first evidence of the care put into the design of the receiver is found in the fine tone quality which is noticeable the minute the receiver is turned on. This feature is so outstanding that even the most inexperienced listener recognizes it immediately. Not only are the low notes present in their full proportions, but the higher notes, which lend color and definition to both music and speech reproduction, are present in a natural but not overemphasized degree.

The presence of the low notes is not the result of special emphasis placed on one narrow band of the lower frequencies, but is due, rather, to the complete reproduction of all the lower



THE RECEIVER CHASSIS

Totally inclosed in chromium-plated shields, the chassis is a thing of beauty. The power-amplifier, power-supply unit (not shown) is a fitting mate for this chassis in both utility and appearance

IN 80 ~~DAYS~~ minutes! WITH THE

WAVE SUPER

fantastic dream. Today it is a mat- single-control, band-switching super- which picks up Australia consistently

ONE OF THE CONSOLE MODELS

This combination includes the receiver at the top, speaker at the bottom and, between them, a drawer containing phonograph equipment

One sound frequencies, down to something below 30 cycles. At 30 cycles, the lower end of the useful audible scale, reproduction is at the same level as the higher frequencies which represent the average of musical and voice reproduction, so far as the ear can detect. Actually, the measured reproduction is about 2 db. "down" at 30 cycles, but as the ear is insensitive to changes of less than 2½ db., this drop is not perceptible. At frequencies between 30 cycles and 600 cycles the reproduction is uniform. From there on up there is a slight rise of about 1 db. at 2000 cycles (not perceptible to the ear), followed by a gradual lowering to 2 db. "down" at 3000 cycles. So far as the ear can detect, therefore, the fidelity curve, measured from the antenna *to the ear*, is absolutely uniform from 30 cycles to 3000 cycles. From this point up the curve, as shown in Figure 1, falls off rather rapidly. This falling off is desirable, because while little of real value is lost, so far as truthful reproduction is concerned, there is a distinct gain obtained from the elimination of undesirable noise which would result from the reproduction of the extremely high frequencies.

Taylor

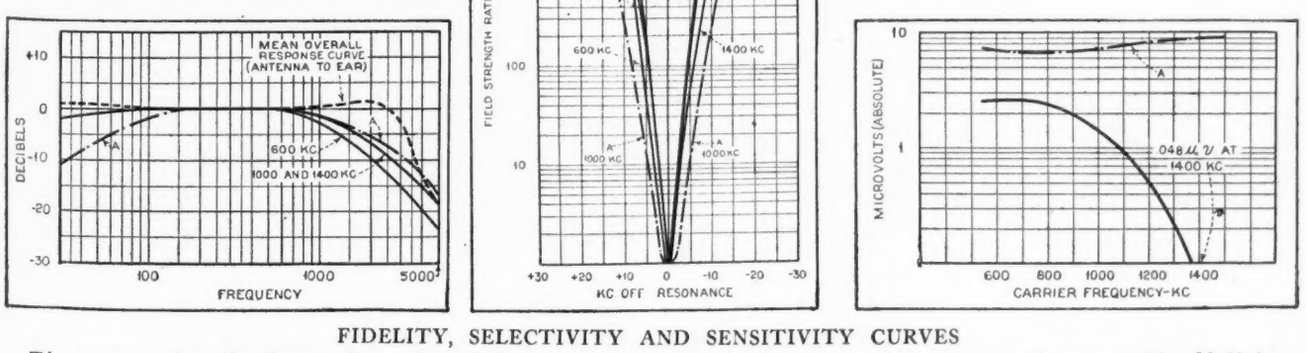
The high volume of undistorted reproduction obtainable from the receiver is another of its features—far greater than can be possibly used in the home and adequate to meet the requirements of even a good-sized hall or assembly room. This volume, moreover, is obtainable not only on the reproduction of programs from local broadcast stations, but on distant stations as well.

After noticing the fine tone quality and overabundant volume, the owner will probably start tuning around with the receiver, and then he will obtain his third distinct impression. The sensitivity on the broadcast band (Figure 2) is little less than astonishing. If the receiver is operating in the evening, from an average location or even from a rather poor one, it will be no trick at all to tune in stations on every broadcast channel on which stations are operating at the time. On two different occasions, a week apart, the writer tried running through the dial from 200 meters to 550 meters, and on each occasion only one channel failed to produce reception. This was the 840 kc. channel (356.9 meters), one assigned exclusively to Canada. Whether this was due to the failure of the station assigned to this channel to be on the air at the time, or whether the transmitter is in a spot that is completely dead so far as this receiving location is concerned. is not known.

Daytime Reception

Operating in the daytime, it will not be difficult to bring in stations on at least half the assigned channels. On Sunday afternoon, May 29, operating the receiver at Fairfield Beach, Connecticut, stations were brought in on 53 of the 96 channels. No effort was made to identify the stations tuned in, because of the vast amount of time that would be required to wait for call announcements from this number of stations, many of which do not announce more often than once every half hour and some not that often, particularly on Sunday afternoon, when church services are being broadcast.

For those who are interested, the following is a list of the channels on which stations were tuned in between 3 p.m. and 4 p.m., Eastern Standard Time. It should be borne in mind that this reception took place in a location which is, generally speaking, not a favorable one. Certainly it is no better than average. Also that reception was not counted unless it was "via loudspeaker" and distinctly understandable. Many stations 150 miles (*Continued on page* 118)



FIDELITY, SELECTIVITY AND SENSITIVITY CURVES

These curves show the characteristics of the DeLuxe receiver compared with characteristics (curves A) averaged for 20 high-grade broadcast receivers. Figure 1 (left) shows electrical fidelity, while the dash line shows overall fidelity from antenna to ear. Figure 2 (right) shows the extreme sensitivity and Figure 3 (center) the selectivity at three different frequencies

1932

THE MODERN TREND

Typical designs for radio receivers of the last year or two include the latest improvements in radio technique, including both radio and phonograph in a cabinet suitable for any home

A LEADING RADIO EDITOR

RADIO'S

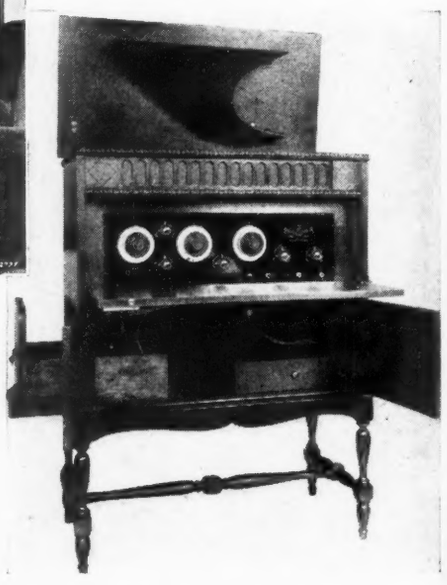
It is fitting that, as* RADIO NEWS *starts service to the radio industry and radio journalist, who is familiar with the review for us the improvements that

By E. L. Bragdon*

FOURTEEN years is not a long period of time as generations come and go, yet within the compass of these years the world has seen the birth of a new industry—the slow but persistent early progress of the radio enterprise and an awe-inspiring pace in development which places that industry among the wonders of the age. With these deeds to look back upon, RADIO NEWS should experience a feeling of pride in the fact that it fostered the start, heralded the accomplishments and shared in the returns. A child fourteen years of age is but beginning a useful existence. This publication of the same age has experienced all the benefits as well as the hardships that would ordinarily be encountered only in a span many times longer than this. And the present phase apparently is but the beginning of other phases that will shine more brilliantly and profitably and with far greater satisfaction.

In a book written by R. P. Clarkson, and aptly titled by him "The Historical Background of Radio," the author quotes two scientists as follows:

"The day will come when we are all forgotten, when copper wires, gutta-percha covers and iron bands are only to be found in museums, that a person who wishes to speak to a friend, but does not know where he is, will call with an electrical voice which will be heard only by him who has a similarly tuned electrical ear. He will cry 'Where are you?' and the answer will sound in his ear, 'I am in the depths of a mine, on the summit of the Andes, or on the broad ocean.' Or perhaps no voice will reply and he will know that his friend is dead."



FORERUNNERS

Above we see a high-powered long-distance receiver in an early type of cabinet. Right: One of the first efforts to put a receiver in a cabinet, with the loudspeaker horn attached to the lid and battery compartments below

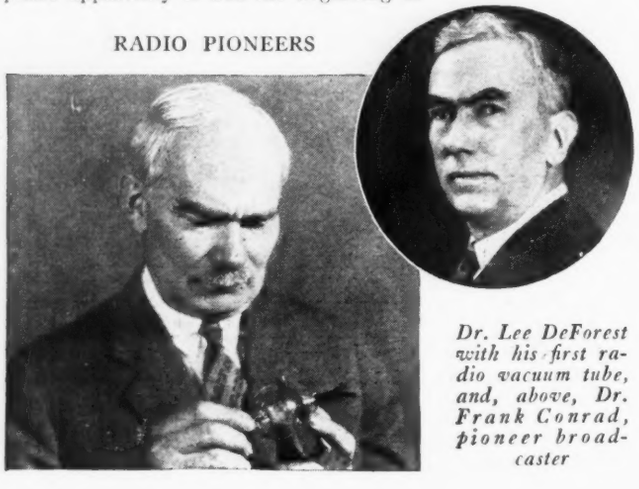
Thus spoke W. E. Ayrton many, many years ago. Again a quotation, this time from a publication of 1898:

"It (broadcasting) might be desirable for the purpose of following the day's happenings, such as army maneuvers, for reporting races and other sporting events, and generally for all important matters occurring beyond the range of the permanent lines (of communication)."

This was the forecast of Sir Oliver Lodge, whose name is linked with scientific developments of the highest magnitude.

Broadcasting, of course, in the modern sense is a modern development but not a modern idea. It required a groundwork of knowledge for these laboratory wizards to clear away

RADIO PIONEERS



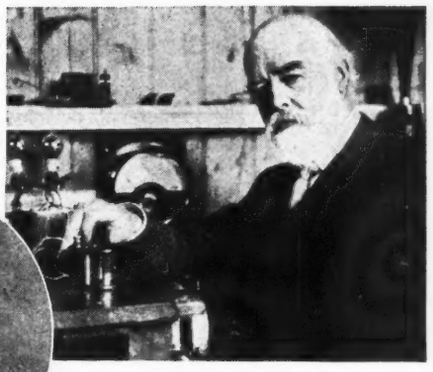
Dr. Lee DeForest with his first radio vacuum tube, and, above, Dr. Frank Conrad, pioneer broadcaster

*Radio Editor, *The New York Sun.*

LOOKS BACK AT FOURTEEN YEARS OF

EVOLUTION

on its fourteenth consecutive year of enthusiasts at large, in bringing to them developments and describing popularly their design and usage, a leading radio history of this development, should have been wrought during this period



WIRELESS WIZARDS

Senatore Guglielmo Marconi, known as the father of wireless, and, above, Sir Oliver Lodge, creator of inductive tuning

the walls of ignorance and mystery before the day foreseen by Ayrton should come to pass.

To label the researches of engineers, physicists and field workers in the early part of this century as "mere groundwork" of the world-wide network of communication as we know it today does not detract one whit from their glory. Without their conquering of stubborn problems, many of them so discouraging in aspect that they must have seemed insurmountable, the world would be poorer today by many billions of dollars in material things and trillions of hours of domestic enjoyment, not to mention the welding together of international viewpoints, all due to the universal appeal of broadcasting.

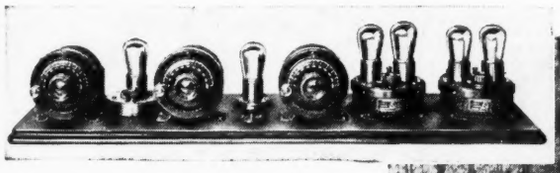
This little tribute to fourteen years of broadcasting might well be carried through to its end without recalling the years that preceded them, but a brief mention inevitably makes the story more complete and understandable.

Back in 1901, Marconi flew his kite over wind-swept Glace Bay and brought down a different kind of lightning. The act was heralded as one of the greatest accomplishments of all time. In the decade that followed, a long list of workers continued the enthusiasm engendered by the Marconi achievement. Gradually the crude mechanics of reception were refined and new elements added which displaced the old. De Forest took a glass bulb and inserted a little piece of metal in a space left unfilled by J. J. Fleming. In that one stride, broadcasting was drawn within the limits of practicability. The war altered the picture at this point, and radio took its place in the ranks alongside the other engines of offense and defense. At the conclusion of hostilities, engineers who had been forced to untoward ends to develop communication through the ether immediately saw the great possibilities of the agency as a supplement to the other great communication systems. At this point radio broadcasting of entertainment, information and education had its birth. And at this same point RADIO NEWS entered the scene as an aide, a counselor, a contemporary history and a reference source.

From the moment that the late Harry P. Davis and Frank Conrad, working before a crude transmitter in a garage at East Liberty, Pa., voiced the returns of the Harding-Cox election, not for the edification of millions of listeners but for the curiosity of two score of friends who had been provided with special receivers, our daily life was threatened with changes. If the prosaic figures of a presidential election could be made so interesting that people would listen to them, then there must be a demand for the same system expanded and refined. The astonishing fact that a family could sit in comfort in its home, there to be supplied with happenings of the day, musical selections and even addresses by notable men whose messages were sought after, swept over the country like the news of a staggering earthquake. The demand for receivers sprang up and an industry was born. The first part of Oliver Lodge's prophecy was coming true, exactly twenty years after it was uttered. But Ayrton, in thought at least, was still ahead of the art.

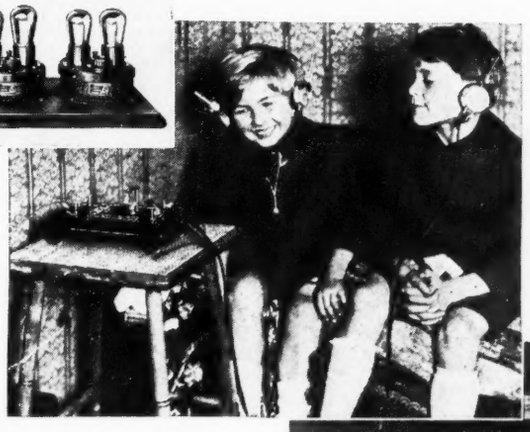
Who is there today who does not remember the awe-inspiring collections of coils, tubes and wires that preceded any concerted manufacturing move? Historians are one in agreeing that this era of home building was the spark-plug that energized inventors and engineers.

There is an erroneous belief that the attic inventor was for several years the (*Continued on page* 122)



EARLY SIX-TUBE SET

This receiver, in which the parts and tubes were mounted on a breadboard layout, was once considered the latest word in home radio reception apparatus



1919

MEMORIES

Some of us do not forget the first crystal sets, as shown above, that brought such a thrill to young and old alike. Right: Fewer remember the good old days when radio was a collection of batteries, mysterious looking coils and parts in scrambled confusion all over the experimenter's table

LATEST EQUIPMENT WITH WHICH

THE DEAF HEAR

TALKING MOVING PICTURES

The relatively high volume maintained at the loudspeaker in the theatre makes this simple non-amplifier type of equipment admirable as a group hearing-aid system

By **Charles H. Lehman***

WITH the coming of the talking pictures, a great cross-section of the motion-picture going public was eliminated as patrons, and with them, often their friends and families as well.

Only those intimately associated with the problem realize the vast number of people who are deficient in hearing. It is reliably estimated that there are over ten million people in the United States alone who are perceptibly hard of hearing. A large proportion of these are able to carry on their regular routine of life without much inconvenience, and often attempt to conceal even from themselves their disability.

The silent picture was a veritable blessing to this great mass of people. During the showing of the pictures, they could forget their disadvantages, follow the action, be heroic with the hero, hiss the villain, shudder under the slings of outrageous fortune, and love with all the ardor of a Garbo or a Gilbert.

Then, as if overnight, a wall of silence was erected between them and the screen. Resentfully they were again faced by a realization of their defective hearing. The theatres lost a patron, and the patron his chief source of entertainment. It is largely through the agitation of this group of people that the undercurrent of objection to the talking picture is kept alive, and with them lies the apparent demand for silent movies. Provision of equipment to enable these people to hear in the theatre will do away with practically all the propaganda in favor of the silent screen.

The Theatrephone, as described in this article, brings back to the deafened the romance of the theatre, the music, lights and the sound of human voices for which they hunger as no one so unafflicted can realize.

The first permanent Theatrephone installations were made in the Warner and Hollywood theatres in New York. Since then, installations have been made in many important theatres throughout the east and midwest, in both large key houses and in small neighborhood and community houses.

In every instance, these installations have attracted much favorable publicity. The local newspapers are all glad to lend their columns to write-ups, because such installations are news. The local Leagues for the Hard of Hearing, the local women's clubs, all coöperate in spreading the news, and a new group of patrons is brought back to the theatre.

*President, Hearing Devices Co., Inc.

IN THE PLAZA THEATRE, NEW YORK

A small jack box under the seat arm provides connections for the headphone. Individual volume control is provided by a sliding button on the headphone handle

Most Simple Type of Equipment

In many instances, patrons have been known to drive twenty miles or more to reach a theatre where they can hear, a blessing little appreciated by those of normal hearing, but a Godsend to those who walk in semi-silence with but little opportunity to join in the enjoyments open to those of normal hearing.

The Theatrephone is an exceedingly simple and ingenious equipment. No connection is made to the house wiring or projection system. The sounds, as they issue from the loudspeaker horn, are picked up by a group of rugged, yet sensitive microphone transmitters, and the carried directly to the headphones.

Figure 1 shows a typical two-group Theatrephone installation circuit. Each transmitter (microphone) unit serves a group of

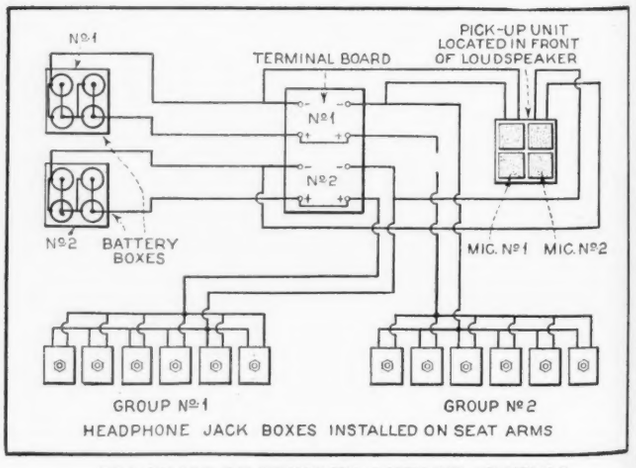


DIAGRAM OF TWELVE-OUTLET SYSTEM

Figure 1. The system shown here includes two groups of equipment, each having its own microphone pick-up, batteries and outlet boxes. More groups may be added

six seats, and each group is practically a separate and independent unit, with its own separate group battery. Additional transmitters can be later installed with accompanying groups of seat outlets without in any way interfering with the stations already installed.

From each transmitter a pair of ordinary flexible telephone wires are run to a junction box. The junction box is usually located at a convenient point back stage, close to the control board, or may be installed in the basement or any dry place.

Ordinary dry cells, furnishing three volts, are used for the voltage supply, and under ordinary service, will last for three months or more. Because of the low voltage, there is no conflict with Fire Department or Underwriters' rules, and of course there can be no objection from the makers of the theatre projection apparatus, because no contact of any kind is made to their wiring.

Installation Data

BATTERIES—For each transmitter group, a battery group of four number six dry cells are required, wired and connected in multiple series, to supply three volts. It is important that the batteries be connected as shown in the drawing. A good method is to provide a battery box, and to stand same upon a shelf either below or to the left of the junction box.

TRUNK LINES. From the junction box, a trunk line is run to each group of seats to be served. Local conditions will determine the most feasible manner to run the lines. In most installations in older buildings, the trunk line can be run along the base-boards or mouldings. In many cases, the line can be run below the floor, and come up to the seat locations through holes drilled in the floor. When running through floors and walls, tape or otherwise protect the wires as an extra precaution.

Having run the trunk line to the group or row of seats to be served by it, run the trunk line to the furthest seat of the group, leaving sufficient length at the end seat to extend to the seat jack-box. Then, at each seat location, tap the trunk line pair and run extensions to the individual jack-boxes of the group.

Do not cut the trunk line. Solder each connection, draw snug, and take up slack wire. Conceal the wiring as much as possible, and watch out for your polarity, being sure to connect positive to positive and negative to negative.

SEAT JACK-BOXES. The outlets or seat jack-boxes in this system are exceedingly small and simple. They consist of a small inconspicuous wooden block 1½ inches square, just large enough to hold a Carter midget jack, and fit under the projecting arm of the seat.

Maintenance

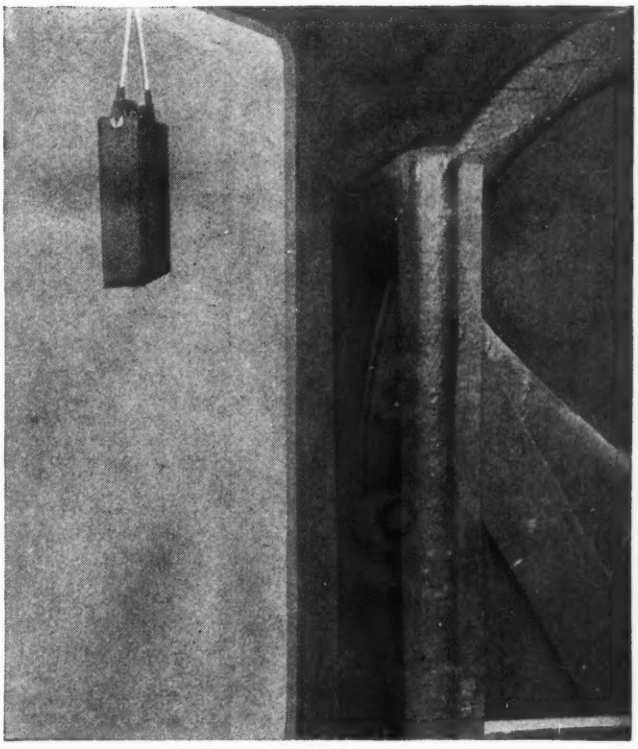
The handsets are especially designed for public use, are exceedingly rugged, and fool proof, and since the volume control is installed within the handle, there is but little opportunity for it to get out of order.

The system, when properly installed, is always ready for use simply by inserting the handset plug into the seat jack. No attention is required except the inspection and renewal of batteries every four or five months. The drain upon the system is so slight that the intervals between usage usually serve to bring batteries up again, so that practically normal shelf life of the batteries can be obtained.

In theatres showing stage or vaudeville performances, a footlight transmitter is installed in the footlights, and the circuit varied so that the leads from both the footlight and horn transmitters are run to an ordinary knife switch, and from there to the junction box, thus enabling either transmitter to be cut out at will.

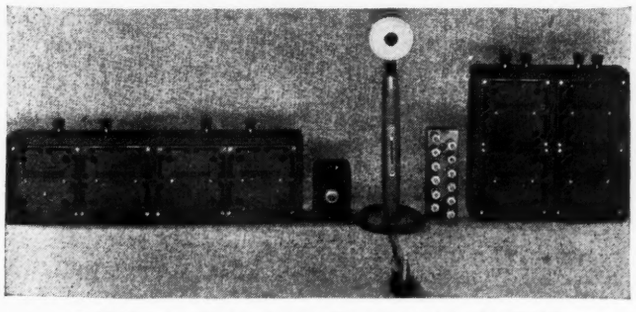
In general, the Theatrephone system herein outlined can be used efficiently by any one who would be able to hear if located within a few feet of the loudspeaker. The reproduction is pleasingly natural, and with the individual volume control device can be so adjusted as to give the practical equivalent of normal hearing to those who now find it difficult to hear even in the front rows of the theatre.

In every theatre, there are sections (*Continued on page* 119)



THE MICROPHONE PICK-UP

The group of microphones is suspended in front of the theatre loudspeaker and just behind the screen. By means of a pulley arrangement, the microphones may be raised or lowered to the positions providing the proper degree of pick-up



PARTS OF THE THEATREPHONE SYSTEM

At left and right are shown two types of group microphones. In the center is one of the headphones. At its right is one of the terminal boxes, and at its left an individual jack box

THEATRES FEATURE HEARING AID EQUIPMENT

This view of one corner of the lobby of the Warner Theatre in New York indicates the merchandising possibilities which the theatre owner attaches to hearing aid equipment of this type

The "Little Chum" Portable

A truly portable receiver which may be plugged into any 110-volt light socket, either a.c. or d.c. It is ideal for the traveler, for use in hotel rooms or anywhere where 110-volt supply is available

OPERATING THE "LITTLE CHUM"

Installation and operation are simple. Plug it into the line, drop a short wire on the floor for an aerial, and it is "set to go." When carrying the headphones fit inside the cover.

By J. B. Davis

IN designing a portable receiver we should take into consideration the conditions under which it will find the most practical use. Naturally, most people prefer a receiver that will give loudspeaker performance, but there are circumstances under which a receiver of this type cannot be used, as, for instance, in the public ward of a hospital or in a hotel room. The cost, size and weight of a receiver giving loudspeaker performance is considerably greater than is the case with a receiver using headphones. Any one or all of these features may be governing factors in influencing many in favor of the receiver described in this article, which weighs about seven pounds, complete with tubes and phones. The outside dimensions of the case are 10¼ inches long by 8 inches high by 6¾ inches deep.

Special Circuit Arrangement

By reason of a special circuit arrangement which the author believes is described here for the first time in any magazine, the receiver can be operated from 110-volt *direct or alternating-current line* without making any change in the circuit or any special connections. In many locations a wire about fifteen feet in length is all that is required as an antenna. A short wire with a spring clip attached to one end, clipped to the bedsprings makes a satisfactory antenna. In steel-frame buildings it may be necessary to hang a few feet of insulated copper wire out of the window.

The type –39 tube, combining the stabilizing features of the variable-mu with the high amplification characteristics of the pentode, is used in this circuit. The amplification factor of the –39 tube when operated with 90 volts on the plate is 300 as compared with 170 in the –36 type when operated under the same voltage conditions.

A –36 type tube is used as a screen-grid power detector, combining great sensitivity with maximum power output, and a single –37 type tube is used as the rectifier. The –37 type tube, when used as a rectifier, is capable of delivering about 14 milliamperes rectified current, which is about twice as much current as is required by the tubes in this receiver.

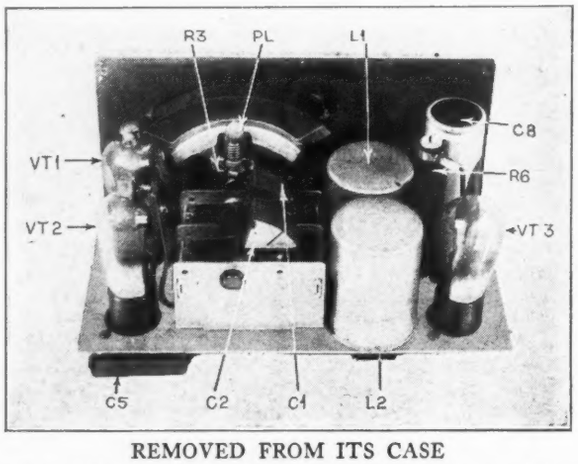
Circuit Description

The advent of the six-volt heater type tube has made possible a compact, efficient a.c.-d.c. receiver. The low filament current drawn by these tubes (.3 ampere) makes it possible to operate several of them with their heaters connected in series, from a high-voltage source, with less current consumption than that of a 40-watt lamp. Other characteristics of this type of tube make it possible to operate it over a comparatively wide voltage variation without seriously impairing the life of the tube. Thus it is admirably suited to 110-volt line operation, as no precautions need be taken against normal line fluctuations.

In constructing the receiver, the polarity, as shown in the diagram, should be observed, just as though the receiver were being built for d.c. operation only. One side of the line is grounded to the chassis, and a 300-ohm filament resistor is connected between the heater of the rectifier tube and the high potential or positive side of the line, the filaments of the three tubes being connected in series. If this order of connection is observed it will eliminate the possibility of developing a high potential between the heater and cathode of the amplifier and detector tubes when operating on a.c. current, due to the fact that the cathode and heater, both of which are grounded to the chassis, will be at the same relative potential on both halves of the cycle.

The antenna coil is grounded to the chassis through a .1 mfd. condenser in order to prevent injury to the coil should the antenna become grounded. No external ground is required, as most lighting circuits are grounded.

Volume is controlled by means of a variable resistor located in the cathode circuit of the



REMOVED FROM ITS CASE

Assembly is within the ability of even the novice, especially if the chassis is made according to the specifications of Figure 3

amplifier tube. The 500-ohm fixed resistor connected in series with the volume control is used to maintain a minimum required voltage on the grid at all times.

Rectifier and Filter Circuit

The main feature which distinguishes this receiver from other types of a.c.-d.c. receivers is to be found in the fact that the rectifying and filtering system is in the circuit whether an a.c. or d.c. supply is used. By referring to the schematic diagram, the action of the rectifier can easily be followed. The grid and plate of the rectifier tube are tied together to form one element. The cathode constitutes the other element.

The presence of the choke in the cathode circuit helps to smooth out the a.c. ripple in the usual way, but the filter condenser serves a two-fold purpose: that of helping to smooth out the ripple and of building up and sustaining a higher voltage by storing the peak voltage when it rises above the average and releasing it for service when the potential has dropped again below the average.

A complete list of parts used in the construction of this receiver will be found at the end of this article. Other manufacturers' parts of corresponding specifications may be substituted, but their mounting requirements should be taken into consideration when the chassis is laid out and drilled.

The primary winding of a Keynon audio transformer having a d.c. resistance of about 400 ohms is used as a filter choke. The secondary leads should be cut off close to the winding and taped to prevent their shorting or coming in contact with any part of the circuit.

All splices and bare leads should be covered with varnished tubing, commonly called "spaghetti."

The word "outside" appears on the case at one end of each tubular condenser. This end should be connected to the point of lowest potential.

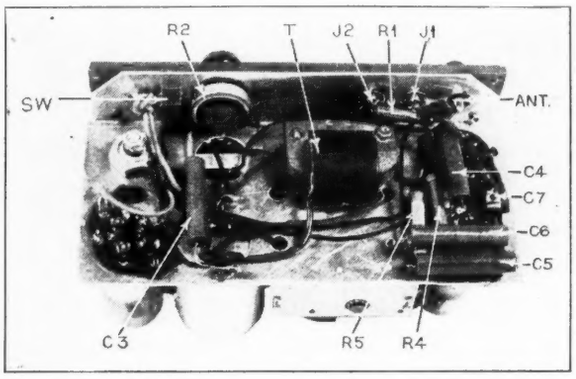
The volume control used here has a metal case to which the shaft with its contact arm is grounded. The mounting nut should be drawn tight on the outside of the panel to insure good electrical contact between the volume control case and the metal chassis.

Particular care should be taken in mounting the 300-ohm resistor to make sure that the terminals cannot come in contact with the electrolytic condenser or the coil shields. A fiber insulating washer should be inserted between the lower end of the resistor and the chassis to prevent the resistor making contact with the chassis. Rubber gromets should be inserted in the holes in the chassis where the wires pass through to the filament resistor and the pilot lamp.

The transformer, the primary of which we are to use as a filter choke, is mounted underneath the chassis by means of two 1¼-inch stove bolts and nuts. Half-inch spacers are used between the chassis and the core to provide a firm mounting.

The tuning condenser is mounted by means of two number 10-32 screws. After the condenser has been mounted, the dial should be slipped on the condenser shaft and the lower part of the dial bracket marked opposite the top of the chassis. The dial should then be removed and the bracket cut off at this point. A number 8-32 oval-head screw passing through the panel just below the tuning knob will prevent the dial frame from moving when tuning the receiver. The screw should be mounted in the panel and the dial permanently adjusted to the condenser shaft before the panel is mounted on to the chassis.

A flexible resistor of 100 ohms value is shunted across the pilot lamp to prevent line surges burning out the bulb. Should the bulb fail to light at once when the receiver is turned on, turn it off again and try a new lamp. This may be an ordinary flashlight bulb rated at 3.8 volts.



THE UNDER SIDE OF CHASSIS

The receiver is compact, but not crowded. As a result the parts are accessible for wiring

Shielded Grid Leads

Leads connecting with the control grids of the first two tubes should be shielded, and for this purpose insulated wire having a fine woven-wire covering is used. The woven-wire shield should be drawn back about a half inch from one end and the conductor cleaned and a grid clip soldered to it. A little solder should be flowed around the shielding to make it stiff and prevent it returning to its original position and so come in contact with the grid clip. The tube should be inserted in the socket and the wire measured to the solder lug of the nearest trimmer condenser and cut off. The shielding should be forced back from the free end and drawn to one side and twisted to form a pig-tail. The conductor is soldered to the lug on the trimmer condenser and the pig-tail is soldered to the head of one of the rivets securing the bakelite strip to the condenser frame. Never leave the grid clip on the tube when soldering wire to it, or the heat will loosen the tube terminal.

Figure 2 shows the layout of the panel to be cut from ¼-inch three-ply wood, stained and varnished or waxed. A detailed layout for drilling and bending the chassis is to be found in Figure 3.

(*Continued on page* 111)

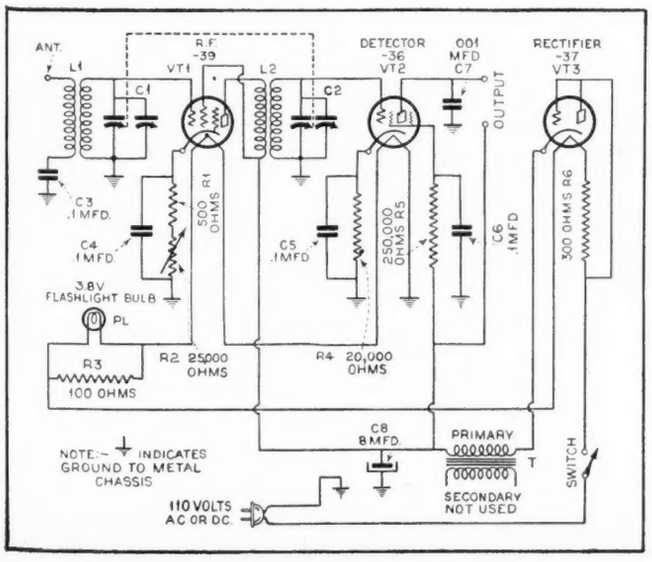


FIGURE 1. THE CIRCUIT DIAGRAM

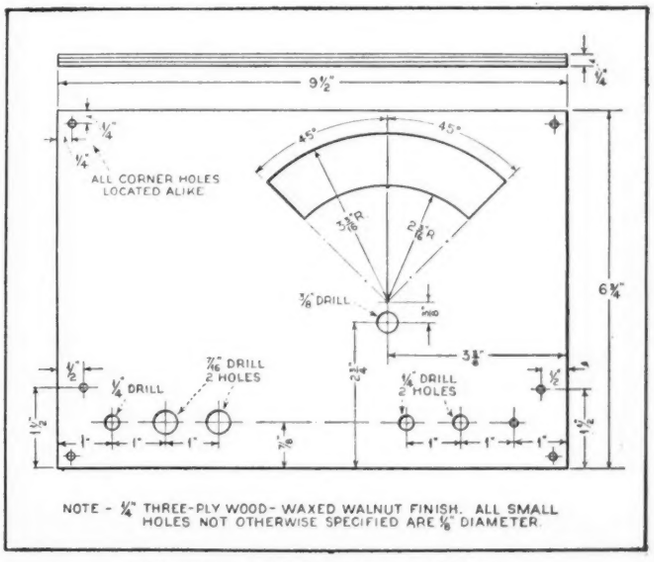


FIGURE 2. THE PANEL LAYOUT

MEASURING NOISE INTENSITIES WITH A

Portable Sound Meter

The physiological effects of noises on people of this machine age, especially as influencing health and efficiency of human beings, is being recognized as of increasing importance. The meter described here is a first step in the solution of noise problems in modern city life

By T. G. Castner*

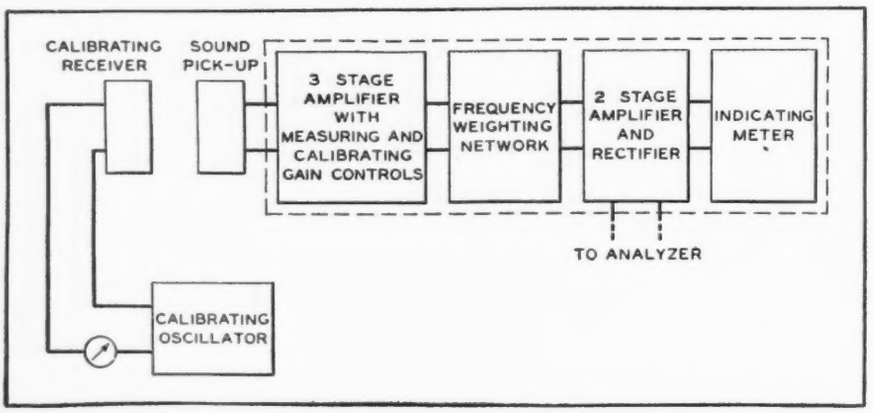
ALTHOUGH the seriousness of room noise in its effect on telephone service has long been recognized, it is only in the last few years that there has been a strong public interest in the reduction of noise in general. In studies both of the methods of noise reduction, and of the effects of noise on people—such as interference with hearing, annoyance and influence on working efficiency and health—measurements of the amount of noise are highly important. Apparatus for such measurements was accordingly developed by the laboratories. Employing an indicating meter to obtain the advantage of a visual reading, it measures noise and sound in general, and has thus been called a sound meter. The appearance of the sound meter, which is arranged in two boxes, is shown by the photograph at the head of this article, and a simplified schematic showing the relation of the principal elements is given in Figure 1.

Measurements of sound are made difficult by the complex relationship existing between the sensation known as sound and its physical cause—pressure variations in the air. The sound meter is designed to receive these pressure variations or waves, amplify them electrically and evaluate the characteristics of the corresponding electrical wave, including its frequency composition, intensity, and duration, so as to produce a measure of the sound.

An electrodynamic transmitter, used as the sound pick-up, converts the sound into electrical energy of the same frequency composition. A five-stage amplifier with a calibrated gain control is employed to raise the energy level received from the sound pick-up sufficiently to give a meter reading at the lowest sound level for which the meter is designed. Between the third and fourth stages of the amplifier is inserted the network used for weighing energies at different frequencies approximately according to their relative contribution to loudness, so that the indication of the meter will correspond, in general, to what is heard by the average ear, and not merely to the physical energy constant in the sound. A rectifier converts the amplified and weighed energy into direct current for operating the indicating meter.

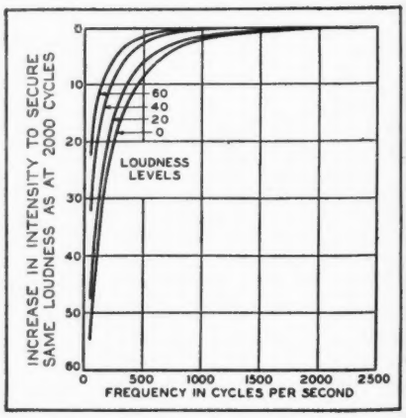
Present data indicates the ear is most sensitive to sound at a frequency in the neighborhood of 2000 cycles; at either higher or lower frequencies greater intensities are required to produce the same loudness. Due in some measure to the way we hear, this increase in intensity is different for each loudness level, and experimental curves, showing the relative increase in intensity for frequencies below 2000 cycles at four different loudness levels, are given in Figure 2. Zero loudness level for

*Transmission Research Engineer, Bell Telephone Laboratories.



SCHEMATIC DIAGRAM OF THE METER

Figure 1. An oscillator and receiver used for calibration are integral parts of the equipment of the new sound meter



THE LOUDNESS OF NOISE

Figure 2. Relation of loudness and sound intensity at four levels

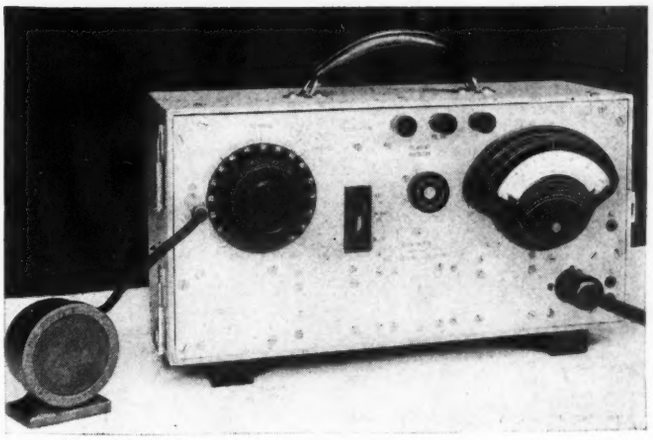
the purpose of this work is taken as the threshold of audibility at 1000 cycles, and other levels are given in decibels above this level—the level in db. being ten times the common logarithm of the ratio of the intensity at the level taken to that at zero level.

An inspection of the curves of Figure 2 shows that only at the lower frequencies are there large differences between the various curves. It seemed preferable, therefore, rather than to complicate the design and use of the meter by employing a network adjustable for loudness, to select some one of the curves of Figure 2 as a basis for the design of the weighting network. That for 40 db. loudness seemed to be the one that would be most useful for general sound measuring work. The network was designed, therefore, to attenuate the received frequencies in a manner complementary to the 40 db. curve of Figure 2. Loudness data is not at present available for frequencies above 4000 cycles, so that for this range the threshold of audibility for the average ear was used as a basis for the weighting curve.

Frequency Components Combined

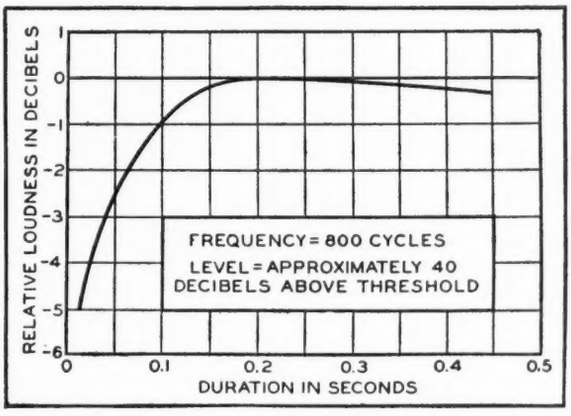
After the complex wave has been weighted by the network, it is rectified so that the combined effect of the various component frequencies is indicated by the meter. Each component frequency, of course, has its own loudness level, but the ear does not recognize these various separate levels, but rather a single level in which the various components are combined in a complex manner. The full-wave rectifier employed, of the copper oxide type, is a square-law rectifier which provides the best approximation to the performance of the ear in combining different frequency components that can be obtained in a simple and portable device. The best available information on the response of the ear to sounds of short duration indicates that the ear appreciates the loudness of a tone lasting two-tenths of a second or more. Loudness of tones of shorter duration is a function of the time during which the tone persists as shown in Figure 3. The indicating meter selected, therefore, is one that gives a full deflection for sounds lasting longer than about two-tenths of a second. It has a long, easily readable scale calibrated over a range of twelve db. The total noise level is the reading on the gain-control dial of the amplifier plus the indication of the meter. The gain-control dial is calibrated in 5 db. steps and in use is adjusted so that the variations in sound may be read on the meter.

The sound meter is calibrated to read in db. above a reference level which is defined as a pressure of .001 dyne per square centimeter of a free progressive wave at 1000 cycles. Chosen because it is definite and easily producible by purely physical measurements, this reference level is approximately 10 db. above the threshold of audibility for the average observer. This primary calibration is made by placing the sound pick-up in a free progressive wave of 1000 cycles at a point at which the pressure has been determined from measurements with a search tube condenser transmitter previously calibrated by comparison with a Rayleigh disc. By a calibrating control on the amplifier, adjustable with a screw driver so as not to be disturbed in use, the gain is set to make the meter read the level of the 1000-cycle wave in db. above the reference level.



MODEL OF THE NEW SOUND METER

Figure 5. The weight of each of the two units, including the meter, pictured above in the battery box shown in Figure 4, is 35 pounds for each unit, making the complete outfit a portable one

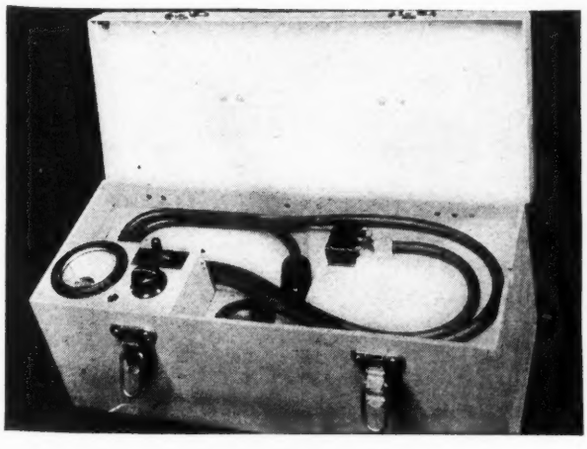


EAR RESPONSE

Figure 3. Shows the response of human ear to sounds lasting fractions of a second

Design Complications

The range of the meter is from 10 to 100 db. above reference sound level. Sound levels less than 10 db. are rarely found in very quiet residences or in sound-proof rooms, and levels greater than 100 db. are almost painful. This 90 db. range, however, requires a high-gain amplifier. This high gain, together with the use of low-power tubes —necessary because they must operate on dry cells—has required a number of precautions in the design of the amplifier. To make the sound meter read differences in level correctly, overloading of the vacuum tubes and feed-back between parts of the circuit had to be made negligible. Sufficient shielding had to be used to make the effects of commonly encountered electromagnetic and electrostatic fields of no importance. Cushion mountings were used for both the vacuum tube sockets and for the amplifier as a whole to eliminate microphonic pick-up.



BATTERY BOX

Figure 4. This photograph shows the calibrating equipment in the battery box that also is used to carry the sound pick-up

Operating Check

Although the sound meter amplifier is very stable electrically, it was thought desirable to include as part of the associated equipment a means of making an overall acoustic calibration in the field so that there will be no doubt that the meter is operating properly. The apparatus for this secondary calibration consists of a stable type of telephone receiver, a small 2000-cycle oscillator for energizing the receiver with a known current and a means of coupling the receiver to the sound pick-up in order to produce a definite acoustic pressure on the pick-up. A small milliammeter mounted in the battery box is used for measuring the current applied to the receiver, and by means of a key may also be used to check the "B" battery voltage. The arrangement of the battery box is shown in Figure 4.

(*Continued on page* 110)

"Professional" Receiver

FOR AMATEURS AND SHORT-WAVE FANS

For the first time a short-wave superheterodyne, designed for use by commercial stations, is made available to the "ham" and the s.w. broadcast enthusiast. It features high sensitivity, low noise level and a most unusual band-spread system

Part One

By Gordon Fraser

THERE are many amateurs and serious short-wave enthusiasts who have envied commercial short-wave receiver equipment. The Hammarlund Comet "Pro" receiver described here is, so far as the writer knows, the first really professional short-wave set to be made generally available.

First of all, it should be pointed out that the term "Professional" as applied to this receiver is not just a hollow boast. A partial roster of the commercial radio services using the set include the following: National Broadcasting Company, Columbia Broadcasting System, American Airways, Eastern Air Transport, American Radio News Service, Aeronautical Radio, Inc., International Communication Laboratories, Bell Telephone Laboratories, U. S. Government departments, National Guard units, Philadelphia Police Department, Pennsylvania State Police and the New York City Police Department. Some of these organizations use a larger number of sets in their various stations throughout this country and abroad.

Aviation and news services, which require absolute dependability in their equipment, were among the first to adopt this receiver. It naturally follows that such a receiver will also meet the requirements of the amateur c.w. or 'phone stations, because, after all, the requirements are identical. An interesting commentary on this phase of its usefulness is found in the following quotation from a letter written by James M. Whitaker, who owns and operates amateur station W2BFB, Bronxville Manor, New York:

"Results with the Comet 'Pro' have far exceeded my expectations. Both on telephone and c.w., the ease of operation, selectivity and volume are surprising. This receiver has made possible reception of foreign amateurs heretofore unheard, due to the lack of background noises in the set itself. I have an outlet for a regular broadcast receiver in my room and received rebroadcast programs while I was receiving the same foreign stations direct on the Hammarlund. The comparison was a revelation. The rebroadcast program was hardly understandable over about half the time, while the output of the Hammarlund was practically the same quality as is usually obtained from a good broadcast receiver on local programs."

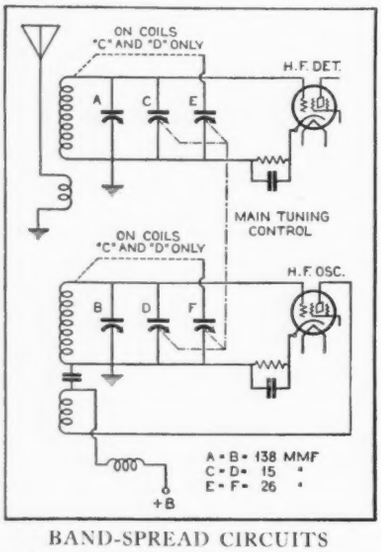
Some readers may have the idea that a satisfactory professional receiver must necessarily be complicated and cumbersome in operation. Such is not the case! The demand for simplicity in operation is greater in commercial service than in the home, for the simple reason that commercial stations are primarily interested in carrying on their business, not in playing around with a multiplicity of controls. Maximum efficiency is, of course, required and controls cannot be reduced at a sacrifice, but the utmost simplicity in operation, consistent with maximum efficiency, is considered essential. In this respect, the aims ideals of the amateur, the commercial station and the short-wave broadcast fan are identical, just as they are in all other features of receiver performance.

The Comet "Pro" is an eight-tube (including the rectifier) superheterodyne, designed to cover the entire short-wave band from 15 meters to 200 meters. All operating power is drawn from the a.c. light lines, the power-supply equipment being built into the receiver, making it a completely self-contained job. Only one audio stage is included in the receiver. A separate power-amplifier unit is available for use where high-volume, loudspeaker operation is required, but the receiver alone is capable of operating a magnetic speaker satisfactorily on all but the most distant stations. For that reason, connections for a speaker of this type are provided in addition to the headphone jack on the front panel.

It is designed for the reception of both voice and c.w. signals. For the latter a special heterodyne oscillator is included in the intermediate-frequency amplifier, with a switch on the front panel which permits it to be cut "in" or "out" at will. For c.w. reception, or for use in locating broadcast stations by its "birdies," this heterodyne oscillator system is ideal, as it does not require any control, such as the critical regeneration control found on most amateur receivers.

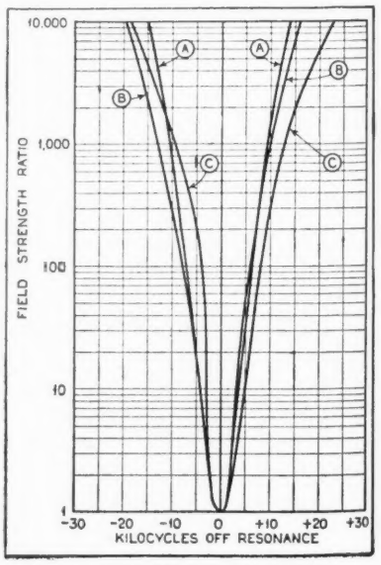
The short-wave band is continuously covered by four pairs of plug-in coils. These coils are wound on isolantite forms and the coil sockets are also of this material, which offers the advantage of extremely high efficiency and, being impervious to moisture and not subject to physical variations, it results in coils that are constant in their values under any and all conditions and remain fixed in their calibration.

The intermediate-frequency amplifier is tune to 465 kc., a frequency below the broadcast band but



BAND-SPREAD CIRCUITS

Figure 2. A and B are the "tank" tuning condensers, while C, D, E and F are ganged and constitute the band-spread system. E and F are automatically cut in when the larger coils are plugged in. For the higher frequencies C and D alone are employed for band-spreading



THE SELECTIVITY CURVE

Figure 6. Curve A was taken at 1500 kc., modulation 30%; curve B at 3750 kc., 70% modulation; curve C, at 19,000 kc., 70% modulation

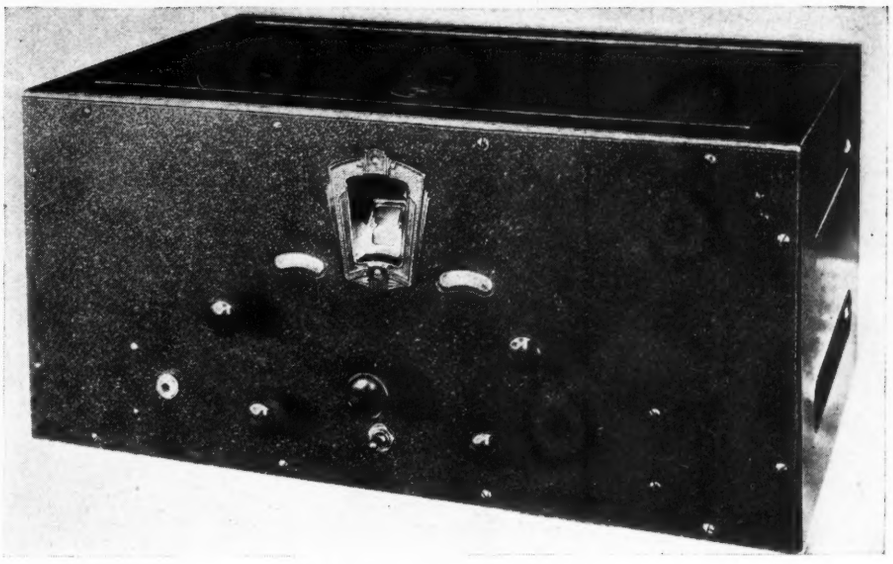
still high enough to provide excellent operation for short-wave "beat" reception. This frequency provides relatively wide separation between the signal and image frequencies with the result that image frequency offers no complications.

Another advantage of this intermediate-frequency is that it permits obtaining a high degree of amplification—with perfect stability.

Band Spreading

One of the most obvious and unique features of the set is the method of tuning employed. It provides band-spread tuning—and real "honest-to-goodness" band-spreading—on all parts of its entire wavelength range! Most receivers provide for band-spreading on only certain bands, notably the amateur bands. But this receiver provides the same feature for the various short-wave broadcast ranges, the police bands, the aviation bands and, in fact, all parts of the short-wave range.

There are two tank-tuning dials and a third or band-spreading control. Using the two tank controls, the receiver tunes like any other duo-control short-wave "super." But the band-spread control offers the unusual feature of not only spreading the range over a large dial area, but also of providing single-control tuning. This latter is accomplished by ganging together the small vernier condensers which are shunted across the two tank condensers so that, once the band (in which the operator desires to work) has been tuned in, all operation within that band becomes single control. Thus when the operator gets right down to critical tuning, he does not have two dials to keep in resonance; he finds stations spread out on that band-spread dial much as are the broadcast stations on an ordinary broadcast receiver. European broadcast stations, which on the average short-wave receiver come in with such razor-like sharpness that it is difficult to tune them in, can be heard over a full degree or more on this band-spread dial.



THE TUNING CONTROLS

Figure 1. The band-spread knob and illuminated dial are in the center. At either side are the two "tank" tuning controls and their calibrated dials. Below (left) is the combination tone control and "on-off" switch, while the volume control is at the right. The switch in the center cuts in-and-out the i.f. beat oscillator.

A good example of the unusual spreading of the bands will be found in operation on the 40-meter amateur band. This band, extending from 7000 to 7300 kc., actually covers 76 degrees on the 100-degree band-spread dial. This is a greater spread than is found on most amateur sets, even those especially designed to spread the band. On the 80-meter amateur band, the spread covers 96 degrees on the dial, and on the 20-meter band the spread is 45 degrees. On the 150-meter band the full-100-degree dial just covers the range, which means that the 'phone band in this range is spread over about 40 degrees.

An operator who is primarily interested in the amateur bands has what is substantially a single-dial receiver, the two tank controls only being used to carry the receiver into the band to be worked.

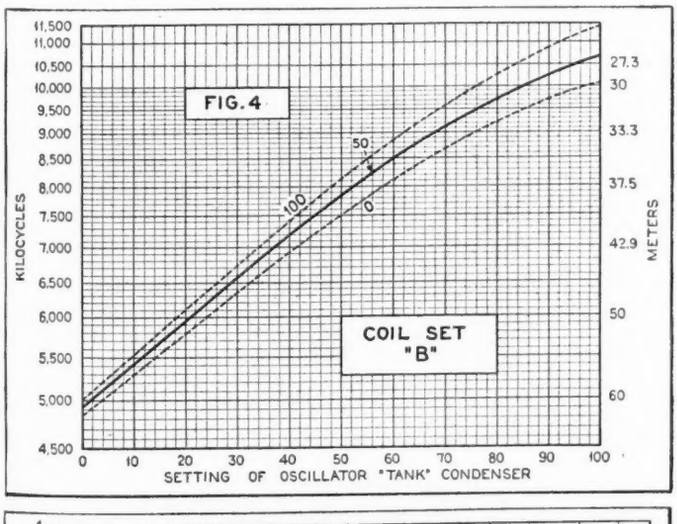
S.W. Broadcast Tuning Simplified

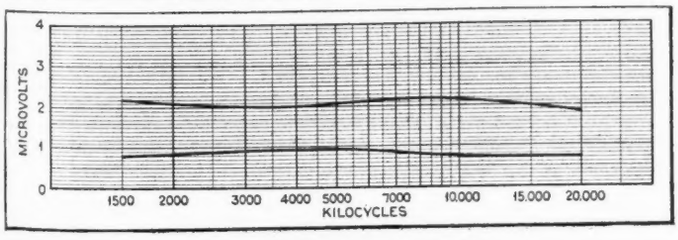
If the operator is more interested in broadcasting, he will find that the range in which the more commonly heard European stations work (25-26 meters) is spread out over 93 degrees on the dial. Rome and Paris, ordinarily found about one degree apart on short-wave receivers, have a separation of 27 degrees, making it a simple matter to tune in between these two for Chelmsford and Winnipeg. Again, in the range around 49 meters, where the greater part of the evening short-wave broadcast reception is found, the range from 48 to 50 meters covers 96 degrees.

These observations will convey a good idea of the excellent tuning qualities of the receiver, but further information will be found in the tabulation of Figure 3 and the chart, Figure 4. The tabulation shows the dial settings and band-spreading ranges for a few of the more popular bands, while the chart shows the tuning calibration for one coil set. The heavy line on the chart represents the setting of the oscillator tank condenser. The setting of the wavelength tank condenser is not shown, as it is always within a few degrees of the oscillator condenser. The two broken lines represent the frequency range of the band-spread dial. To use the chart, the operator determines the midpoint of the band in which he desires to tune and from the chart finds the oscillator tank setting for this wavelength or frequency, first setting the band-spread control on 50, and tuning the receiver accordingly. The vertical distance between the (*Continued on page* 123)

TUNING CURVE FOR 30-60-METER COILS

Figure 4 The heavy line shows the setting of the oscillator "tank" condenser for any given wavelength. The broken lines represent the wavelength range covered by the band-spread dial for any setting of the oscillator condenser





THE SENSITIVITY CURVE

Figure 5. The upper curve shows the sensitivity to 'phone signals, the lower to c.w. signals

RELATING THE FIRST EXPERIENCES OF A

Short-Wave Fan

By W. Franklin Hopf

IT was on Friday the 13th when, in a weak moment, I decided to give the short waves a break. I went downtown and discovered where I could get a fairly respectable one-tube short-wave outfit for the mediocre sum of $6.95—less the tube. With the tube, the outfit set me back $8.00 and some odd cents (but nevertheless, they were cents). The batteries had been purchased some time before this, during another of my weaker moments. The earphones were also in my possession; they had been an outlet for my crystal set before I "rubbed it out." Of course, I had an antenna, but this does not make much difference, as you shall see later on.

Next day I put the set in my room, so as to reduce friction with the family!

The fourteenth proved to be a red-letter day for me. The set worked as soon as I hooked it up, which was 7 p.m. The first thing that bounced at me was W8XL, Cincinnati, O. Andrew H. Brown was the first human voice that came over the set. After sixty-one seconds I left him, or he might have left me, but I do know that it wasn't my fault. The set would not oscillate any longer! Signals faded right away.

I then decided to change the earphone terminal from 45 volts to 22½; 45 volts seemed to be too much power for Andy. To my awe and surprise, it worked! Of course, I had this confirmed. I'd never forget a big detail like that. A member of the family was called in to perform this duty, and her signed testimonial will be sent to anyone who requests it.

By this time the radio downstairs was in operation. Needless to say we were both using the same antenna. The ruling voice (my wife's) decreed that I must sign off immediately, if not sooner, so that was that. I went out in disgust.

At eleven o'clock I tuned in once more. To my surprise and horror, Andy Brown was still talking. What a man! Seven to eleven without a stop. I wonder what kind of cough drops or cigarettes he uses. When the oration was finally concluded, the station was announced as W9XF, Chicago, 6,020 Kilocycles (and this is called a short-wave set). Oh, well, I guess I'll get plenty of surprises before the tube goes West.

Why doesn't someone invent a translator to connect with the radio? I picked up XDA, Mexico City, and could not understand a thing but the announcement. Some day, when I get some spare time, I may invent a translator. That would be a crusty trick to play on the foreign stations, but they wouldn't dare to call me names after I put my translator in the circuit. That was Saturday night.

On Tuesday morning I rolled out of bed a few minutes before seven. I tuned in on a station in California just as it was signing off. The announcer was telling me that it was 4 o'clock Pacific time, but I knew right well that it was 8 o'clock Eastern Daylight Saving Time. He must have thought that I was an Eskimo. That wasn't so bad, but when he said that he was going to bed, I knew that it was Walter Winchell. He is the only person that I know of that sleeps all day and goes out at night, and says things that make you mad. And so to work.

As soon as I got home that evening I dashed upstairs to my set. I listened to W8XK, Pittsburgh, until I lost it (reward offered to finder), and then I picked up a whisper that identified itself as W3XAL, Boundbrook, N. J. Later in the evening W3XAL came in so loud that I was able to hear it on a cone speaker four inches in diameter.

When I picked up a station at St. Georges, Bermuda, I nearly swooned. The Englishman who was talking was so polite that he forgot to announce his call letters. I was going to write to him for a card of confirmation, but, on second thought, I guessed he didn't have any. Maybe that is why he didn't announce his station letters. If enough stations send me their confirmation cards, I won't have to have my room papered next Spring. I guess you know by this time that I am an optimist.

On Wednesday evening I made a startling discovery. When I turned the set on, I forgot to throw the antenna switch. Stations came in as good as they did on other nights, and maybe better, because I heard some girl talking by radiophone. I can't tell you what I heard because it's against the law, but if you really want to know, you can write me a letter.

To get back to my discovery, when I turned the set off, I reached for the antenna switch and, believe it or not, it was off already!

Up to this time I had been using only 1.1 volts on the filament. It really could stand 2 volts, therefore I connected two dry cells in series, so as to get 3 volts. The directions that came with the set declared that you *could* use 3 volts, because the set put up a resistance so the voltage was dropped to the correct value for the tube. Now I know why people say "never believe everything you read." The directions must have got mixed up and put in the wrong box at the radio factory, because the tube ceased functioning altogether. Now I'm saving up for another tube and more adventure.

Latest Advances In

Modern "Super" Design

This ten-tube super, employing the newest tubes, includes a "Class A" audio channel and provides automatic volume control plus an effective noise suppression arrangement. It covers the police as well as the broadcast band

By McMurdo Silver*

IN the July, 1932, issue of RADIO NEWS the writer compared the merits of various audio amplifying systems and presented evidence that the best possible audio system for home reproduction would utilize straight –45 triodes operated in push-puil as Class A amplification.

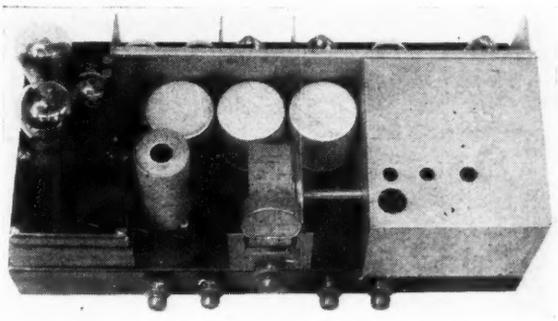
Described herewith is the new S-M 728 ten-tube superheterodyne, just introduced at the May Trade Show, which incorporates this ideal output system. It has other interesting features in that, besides the broadcast band, it will also tune to all American police-call frequencies and employs the new –56, –57, –58 and –82 tubes as well as two –45's. Moreover, it has true automatic volume control and a unique system of noise suppression, a highly desirable feature with a true a.v.c. system, which ordinarily jumps sensitivity (and noise) to a maximum between stations.

The sensitivity of this receiver is greater than can be used in many American locations of even low prevailing noise level, and its only real justification is a wide margin of reserve. Yet, lest the fear be entertained that such high sensitivity will result in excessively noisy reception, the threshold sensitivity can be cut to any level sufficient to definitely shut out any and all local noise, no matter how much it may vary in different locations.

Figure 5 illustrates the operation of the a.v.c. system, curve A showing its operation at maximum receiver sensitivity. It is seen that the power output will vary from only 7.5 to 9 watts for signals of from 50 microvolts absolute on up, assuming the volume control to be turned full on. This is extremely nice control, since the ear can barely discriminate between 7.5 and 9 watts output.

Curve B illustrates the operation of the noise suppressor—the change from curve A is made at the throw of a switch. Actually, curve B is the extreme noise suppression condition possible with the set, where all noise—and signals—below 80 microvolts absolute are cut completely out.

The adjustment to provide curve B is accessible to a screwdriver on the rear of the set chassis, in order that it may be set to suppress the noise prevailing in any particular location. For example, noise levels will vary from only a few microvolts in a good location up to 60 to 80 microvolts in a business section of a city, and cannot be determined in advance. Hence it may be desirable to have curve B cut off at different points between A and B of Figure 5. This is determined upon installation of the set by throwing the switch to its "silent" position, turning volume full on and then adjusting the screw-driver adjustment until just no noise is heard. Then by throwing the switch, either the condition of maximum sensitivity with prevailing noise is had or a condition of sensitivity somewhat reduced and noise completely cut out—for local and all but extreme distance reception. This



THE CHASSIS OF THE MODEL 728

Figure 1. Here the tube shield at the rear has been removed. In the foreground, above the tuning knob, is seen the resonance indicating meter

*President, Silver-Marshall, Inc.

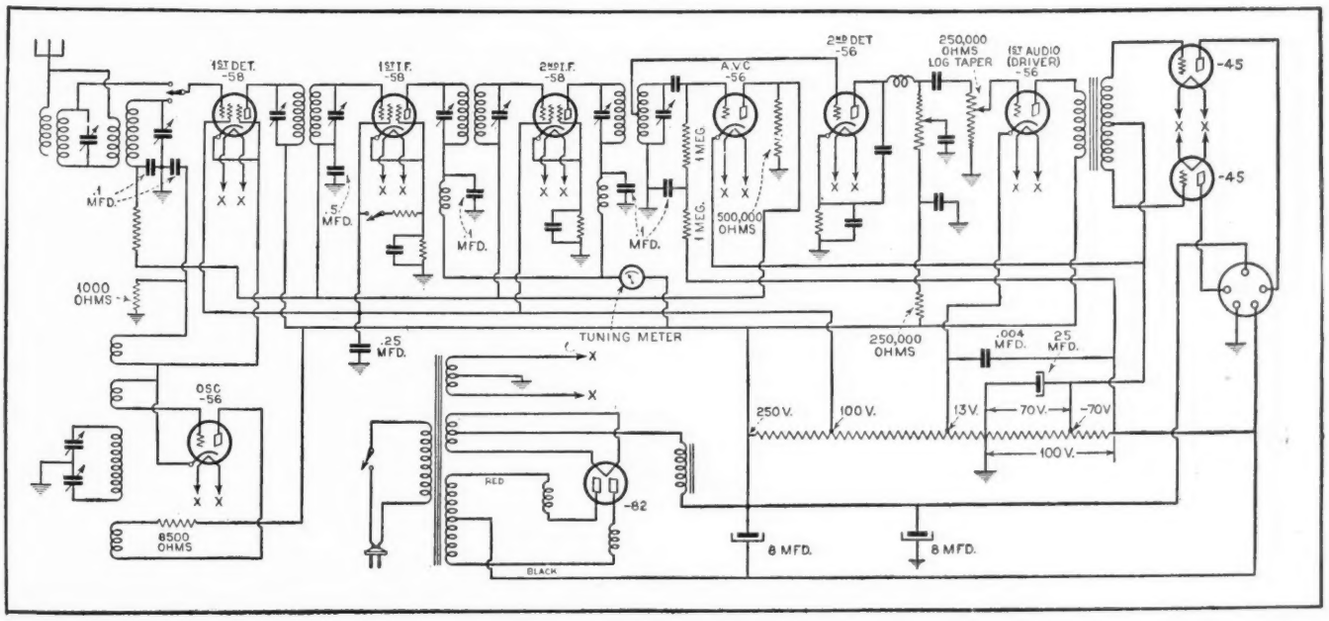


FIGURE 3. THE CIRCUIT DIAGRAM

condition can be set in Chicago so that the principal stations all over the United States can be heard with no background noise whatsoever—a most unique experience.

In Figure 2 the harmonic distortion curve for the audio amplifier appears. Throughout the home-volume range of 200 milliwatts (.2 watt) to 2 watts, the harmonic distortion is seen to vary from only .4 to .6 percent—a small fraction of the distortion found in even the best pentode and –46 Class B amplifiers. It rises to 5 percent at just over 8 watts output and reaches 9 percent at 10.2 watts output, hence the rating of 8 watts undistorted power output (I.R.E. standard). Yet the quality at 10 watts is still very good indeed, due to the masking effect of harmonic distortion at high volume to the ear.

Dual-Wave Reception

Such, then, are the operating characteristics of the new set. Turning to Figure 1, a top view of the chassis with the main tube shield cover removed, the tubes from right to left are –58 first detector, –56 oscillator, two –58 i.f. amplifiers, –56 a.v.c. tube, –56 second detector, –56 first audio stage, the two –45 output tubes, and, in its separate shield at the left front, the –82 rectifier tube.

Examining the circuit diagram of Figure 3, at the left is the dual antenna circuit, which alone is switched to select between the broadcast and police-frequency bands, the oscillator operating above the signal frequency for the broadcast band and below the signal frequency for this police band, this arrangement obviating any oscillator circuit changes (see June, 1932, issue of RADIO NEWS for details).

The antenna circuit is tuned by one section of the gang condenser for the broadcast band, and a separate antenna coupler is tuned by a compression condenser for the police band. The first detector tube is a –58 vario-mu rather than a straight –57 or –24 screen grid to obviate cross modulation and to aid in volume control, the a.v.c. tube serving to automatically change the control grid bias of the first detector and both i.f. tubes simultaneously. This necessitates less negative bias for effective control on these three grids than would be needed on two grids alone and is most helpful in eliminating, not so much the usual form of cross modulation, but the form of it where the result is apparent broad tuning on powerful local stations due to insufficient rejectivity of the single-tuned input circuit for powerful local signals on channels adjacent to them. It further prevents distortion due to the effects of a very powerful signal adding to the oscillator voltage (about 10 volts) fed to the detector grid, a point previously treated in a rather haphazard manner in superheterodyne design.

R.F. Pentodes

A fixed bias is provided for the –58 first detector by the voltage drop across a 1000-ohm wire-wound resistor common to the oscillator and first detector grid returns, the fixed bias on both tubes obviously being equal. The bias of the first detector is further varied with signal strength, the variable bias of the a.v.c. tube being brought to the first detector antenna coil return through an isolation resistor connected to its lower end.

The oscillator is the usual S-M tank-tuned circuit using a –56 tube, but operated from 250 volts plate with an unbypassed plate resistor of 8500 ohms. This resistor serves three purposes. It reduces the plate voltage from 250 to a reasonable oscillator value, prevents frequency shifting with line voltage fluctuations and tends to stabilize the oscillator output at different frequencies.

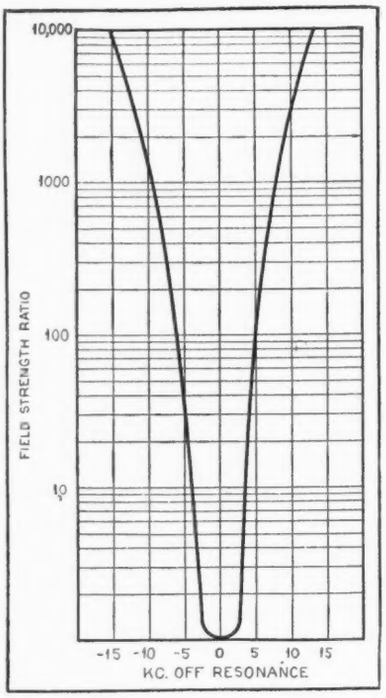
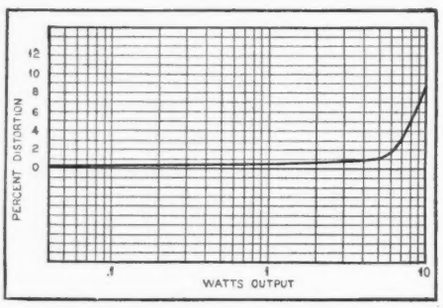
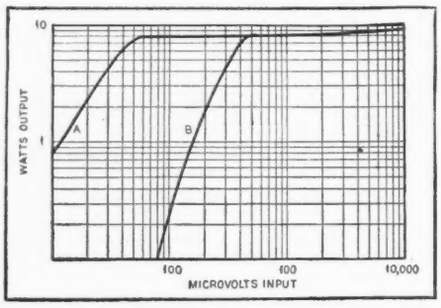


FIGURE 4. SELECTIVITY



HARMONIC DISTORTION

Figure 2. Harmonic distortion up to 5 percent is generally considered permissible, but here it will be noted that it is kept under 1 percent up to 5 watts output



AUTOMATIC VOLUME CONTROL

Figure 5. Curve A shows how constant the volume is maintained for all input signals above 60 microvolts. Curve B shows the alteration resulting when the noise suppressor circuit is adjusted for maximum effectiveness

The i.f. amplifier is not new to RADIO NEWS readers, being essentially the 465 kc. amplifier described in the April and June, 1932, RADIO NEWS. It is changed only to adapt it to the new –58 vario-mu r.f. pentodes. It gives a gain of approximately 150 times per stage. There are two interesting features about it, however—the noise-suppression circuit and the method of taking off the a.v.c. actuating voltage. The noise-suppression circuit is simplicity itself—it is merely a switch and a variable resistor which allows the fixed control grid bias on the first i.f. tube to be increased. The resistor merely bleeds current through the permanent bias resistor of the first i.f. tube to the required degree. The switch is on the front of the chassis. The visual tuning meter is in the plate return of the two i.f. tubes.

Automatic Volume Control

It has been found desirable to take a higher signal voltage off to actuate the a.v.c. tube than is applied to the audio detector grid to get good stiff automatic volume control, and in our previous a.v.c. sets this voltage was taken off the last i.f. primary rather than secondary for this reason. This was found confusing to servicemen, as it permitted improper alignment of the last i.f. trimmer unless great care was used. Consequently, in this new set, to satisfy the condition, the second detector grid is tapped off at about the midpoint of the last i.f. secondary, and the a.v.c. actuating voltage is taken across the whole secondary.

The Audio Channel

The rectified carrier voltage developed by the –56 a.v.c. tube across its 500,000-ohm plate resistor is applied to the first detector and both i.f. grids in addition to the fixed bias, and automatically holds the signal voltage on the –56 audio detector grid to the value needed to turn out 10 watts of audio power from the set when the applied signal is stronger than 50 microvolts.

The –56 second or audio power detector turns out a greater audio voltage than would a –27 detector and is resistance-coupled to the –56 driver stage, with an r.f. choke and by-pass condenser in its plate circuit and in addition an audio filter consisting of a well by-passed 25,000-ohm resistor in its d.c. plate lead.

Tone control is effected by moving a condenser up and down the plate-coupling resistor, and volume control is effected by moving the –56 driver tube grid up and down the grid-coupling resistor.

The –56 driver or first audio stage is not a pure voltage amplifier stage, but is also a power amplifier stage, for it must (*Continued on page* 110)

OPENING UP THE QUASI-OPTICAL WAVES

BELOW TEN METERS

WITH A 3-10 METER SUPERHETERODYNE

By **James Millen***

THE evolution of ultra-short-wave receiving systems toward the logical development of a highly efficient superheterodyne was considered in our second article. And now a new and different superheterodyne receiver emerges from the laboratory in the thoroughly practical and advanced design diagrammed in Figure 1. The receiver is best described by a detailed consideration of the circuit.

Casual inspection of Figure 1 will indicate several points of conventionality—first detector or mixing tube inputting directly from the antenna coil, followed with two intermediate frequency tubes and the second detector (demodulator) which outputs directly to push-pull pentodes. However, variations from the usual procedure will be found in the electronic coupling arrangement between the oscillator and first detector circuits, the regenerative first detector, the single-tuned circuits in the intermediate-frequency amplifier and in the beat-frequency oscillator coupled to the second detector tube. Further analysis will bring to light more subtle originalities in the operating biases and in the working out of circuit details. The antenna-coupling system has been designed in a successful effort to eliminate dead spots in the tuning range, which are particularly noticeable when a regenerative circuit is coupled directly to the antenna. Such points exist when the natural period of the antenna or one of its harmonics, falls within the tuning range—an inevitable condition in the case of an ultra-high-frequency receiver. It was found that the effects of harmonics could be eliminated by the inclusion of a very small capacitor, C1 (1 mmfd.), in series with the antenna. Due to the fact that the first detector circuit is of very high impedance, having negligible losses and efficient regeneration, the minimizing of the series antenna capacity entails no appreciable signal attenuation. Also, the antenna capacity has no effect on the tuning control, because the total shunt capacity must always be less than the value of the series condenser.

It should be noted, however, that this arrangement is only effective in eliminating dead spots caused by harmonics of the antenna period, other than the fundamental, and it is necessary therefore that the aerial does not resonate in the operating frequency band. Almost any aerial over 15 to 20 feet long will be satisfactory.

While it is recommended that the antenna and oscillator coils, respectively L1 and L2, be purchased ready wound, the data in Table 1 are given for the benefit of amateurs possessing the experimental facilities and patience requisite for the fabrication of the correct inductors. All coils are wound with number 18 enameled wire on R-39 low-loss forms, 1 inch in diameter and threaded 8 turns to the inch. The coils plug into the special four-prong sockets designed for ultra-short-wave

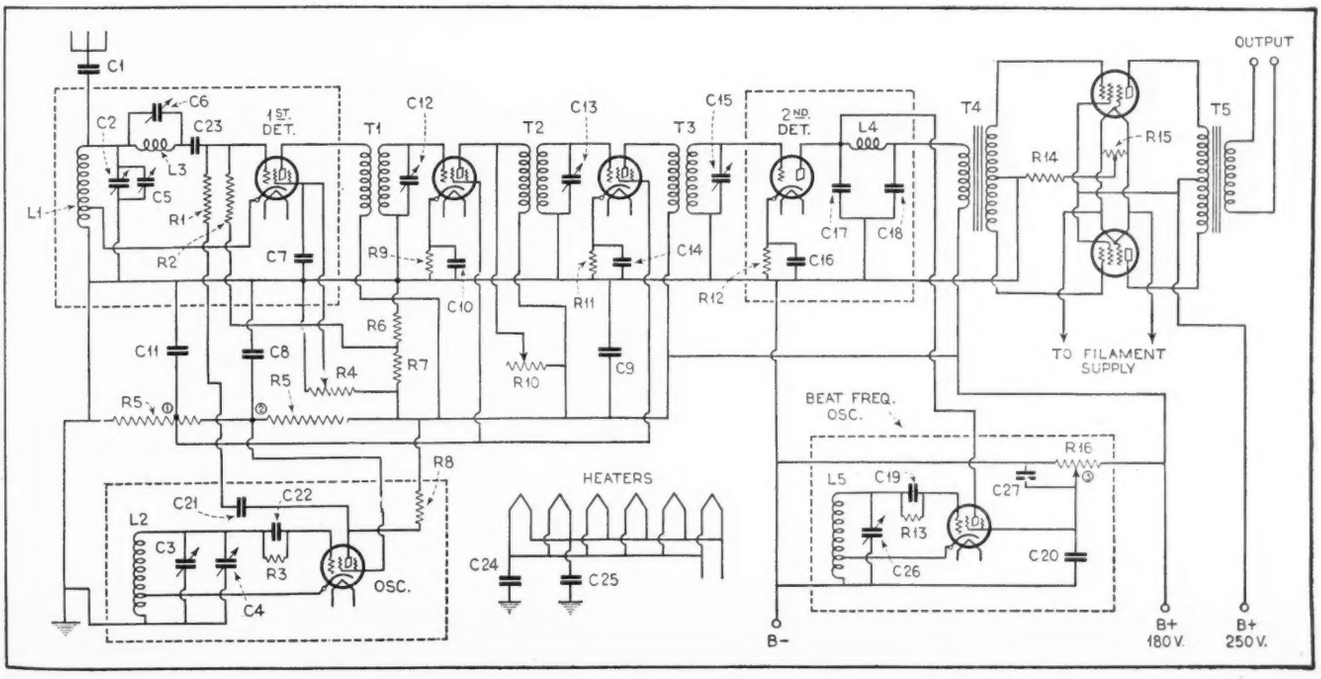
Increased Selectivity and Range

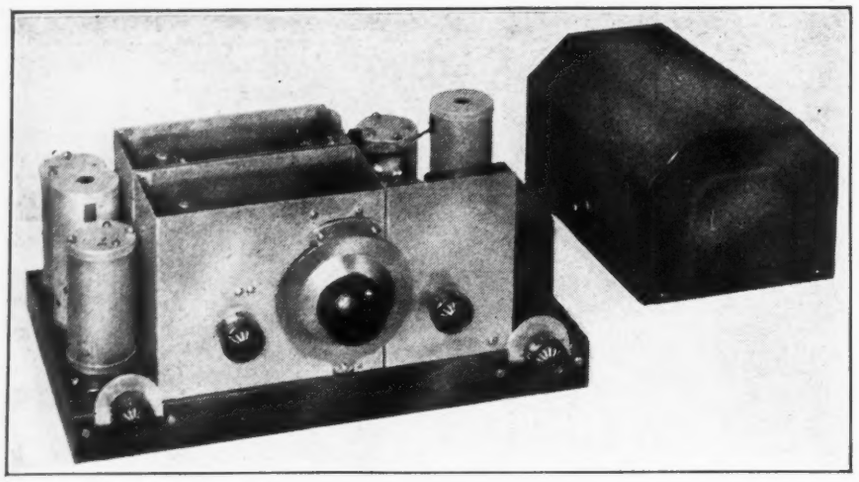
INTRODUCTORY articles of this series considered the characteristics of ultra-short waves, experimental work involved in their exploitation and the general requirements for reception. With the increasing congestion on the quasi-optical channels accompanying more widespread experimentation and commercial use, the desirability for a more selective receiving system becomes a matter of importance second only to the necessity for increasing the range achieved by the superheterodyne and the employment, in it, of developments which reduce background hiss.

*The National Co.

SCHEMATIC WIRING DIAGRAM OF THE ULTRA-SHORT-WAVE SUPER

Figure 1. This circuit diagram shows the exact connections of all the components used in the new set and the dotted lines indicate points where shielding of a high order is essential





FRONT VIEW

Figure 6. Above shows what the receiver looks like with the top of the cans removed and set up alongside of the power pack. At right: Table giving coil data

METERS	NUMBER OF TURNS ANT.	OSC.	TAP-TURNS FROM BOTTOM ANT.	OSC.
3¾ - 4½	1	¾	¼	¼
4½ - 5½	2	1½	⅜	⅜
5½ - 6½	2⅞"	2⅜	⅜	½
6½ - 7½	3¾	3	½	⅝

receivers and described in detail in RADIO NEWS for July.

The first detector and oscillator circuits are tuned by their respective condensers, C2 and C3, of the straight-frequency-line type. These capacitors are double spaced and have maximum capacities of 12 mmfd. The use of isolantite insulation preserves the high-frequency efficiency, and the plates are sufficiently rugged to eliminate microphonic effects which are especially emphasized on ultra-short waves. Condenser C4 is an 8 mmfd. padding condenser which provides excellent tracking, only slight variations of the trimming condenser, C5, being required for the reception of very weak signals.

The tuned circuit L3-C6 is a trap circuit tuned to an intermediate frequency of approximately 1550 kc. Its function is to apply the intermediate frequency to the grid of the detector tube by preventing its return to ground through the low-impedance coil L1. Similarly, L3-C6 offers a low impedance to the signal frequency. It is obviously essential that the losses in this trap circuit be minimized, which consideration predetermines a small-Litz-wound coil and a condenser with a negligible power factor. The capacity to ground must also be low to maintain a minimum circuit capacity. Coil L3 is wound with 100 turns of 10-38 Litz wire on a ⅝-inch form. The tuning condenser may be of the compression type, providing high-grade mica and other fine insulation are used. The capacity required to resonate will be in excess of 30 mmfd., a fairly high capacity being desirable in order to reduce the impedance to the signal frequency.

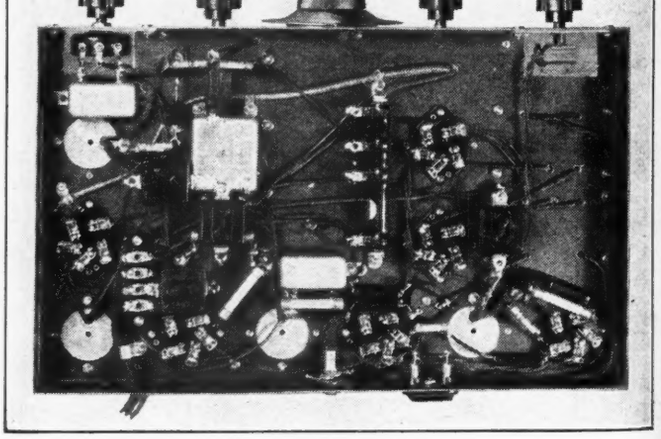
The trap is located in the high-potential side of the grid circuit, so that lower frequency disturbances, such as static, will be by-passed to ground through the tuned-grid circuit.

Electronic Coupling

While the Dow or electronic-coupling system was given detailed description in the July number of RADIO NEWS, further explanation is justified in reference to the specific circuit under discussion. The screen grid, the control grid and the cathode of the oscillator tube form the three elements of a conventional triode oscillating system, the frequency of which is governed by the values of L2, C3 and C4. The oscillating variations in the electron stream cause corresponding variations in the plate current which are resistance-coupled to the load or first detector circuit through R8, C21 and R1. It is obvious that the oscillatory impulses are conveyed only through the electronic stream (providing proper shielding is maintained, as is most essential) and that any variation in the load conditions can have no reactive effect on the frequency. It may also be shown that changes in the plate voltage results in frequency-variation effects, through the screen grid and the plate, which nullify each other, the net result being an exceptionally stable oscillating system (comparable to crystal control in stability, but having the necessary advantage of variable-frequency control) which makes the ultra-short-wave superheterodyne practicable.

The First Detector Circuit

The experienced amateur may comment mentally on the fact that grid-leak detection has been employed in this circuit, apparently in defiance of the general favor toward plate-current-curve systems. Simple analysis of the detecting system will indicate that the grid-condenser arrangement is satisfactory for audio-frequency demodulation, but does not offer a sufficiently high impedance to an intermediate frequency to build up an effective grid voltage. However, the trap circuit, which has already been described, overcomes this objection, making it possible to take advantage of the weak signal sensitivity characteristic of grid-condenser detection. It was also found that the resulting use of a positive bias on the first detector (mixing tube) simplified the attainment of satisfactory regeneration, controlled by the variable resistor R4. By increasing the amount of positive bias on the detector grid until the tube drew a few microamperes, detector efficiency was improved, at the same time reducing the required amount of regeneration for a given signal response. The increase in screen voltage required for effective regeneration similarly increased the *apparent* detection efficiency. This may be explained by consideration of the fact that the tube is also functioning as an i.f. amplifier, and the increased amplification accompanying an increase in the screen voltage more than compensates the customary reduction in detector efficiency.



LOOKING UNDERNEATH

Figure 5. This view gives the general idea of the parts disposition under the base

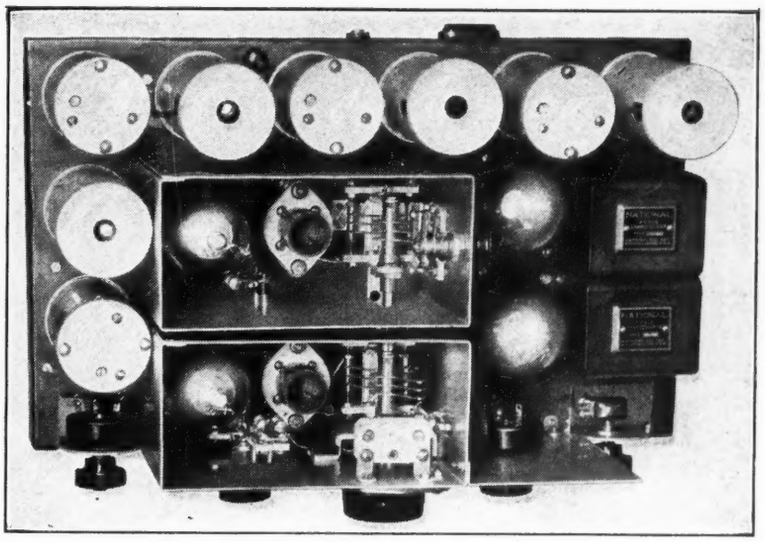
The first detector is followed by a broadly tuned intermediate-frequency amplifier. The three i.f. transformers are tuned only in the secondary circuits, the overall amplification being equivalent to two stages, with both primaries and secondaries resonated to the intermediate frequency. This achieved degree of broadness is desirable, resulting in easier tuning, better quality on amateur signals and television and simplicity of adjustment and increased stability of the receiver as a whole. While, again, the recommendation is for commercially manufactured units, the i.f. transformers can be home-wound on 1¼-inch-diameter dowels with 100 turns of No. 28 wire (primary) and 50 turns of No. 30 double-silk wire on the

secondaries. The secondary is wound first, in a single layer, and the primary, also in a single layer, on top of the secondary, starting at the low-potential end and extending beyond the high-potential end. The lower end of the primary is also the low-potential terminal. Both windings are in the same direction, and may be separated, if desired, by a thin sheet of high-grade insulating paper. The secondary tuning condensers are of the compression type, having ranges between 4 mmfd. and 70 mmfd.

The volume-control action, through variable resistor R10, is limited to the i.f. circuit and has no effect on the plate voltages, in order to eliminate any interaction between the regeneration and the volume controls.

The second detector is of the bias type and outputs directly to push-pull pentodes, type –47. The use of pentodes in this receiver results in a minimum of tubes, with adequate output, a desirable feature in an experimental receiver. The rising a.f. characteristic of the pentode provides a compensatory effect for side-band cut-off in case of excessive regeneration on weak signals.

The radio-frequency choke, L4, may be a convenient lattice-wound coil having an inductance of approximately 500 microhenries.



TOP VIEW OF RECEIVER

Figure 4. This illustration shows the location of all parts mounted on the sub-panel. The layout must be followed closely

While the beat-frequency oscillator presents nothing novel from a circuit point of view, it must be carefully shielded so that only the correct degree of controlled coupling is effected to the second detector alone. Improper shielding will result in the blocking of the intermediate-frequency amplifier, or result in interference caused by the radiation of spurious harmonics in the high-frequency signal band. The beat-frequency oscillator is also electronic-coupled to the second detector. As the intermediate frequency is constant, the beat note is adjusted, by means of C26, for the desired pitch, after which no further adjustment is required. It is important that this adjustment be made with the station properly tuned. The attainment of this same tone or note may then be used as an indication of perfect tuning on other stations.

Coil L5 can be wound on a 1½-inch diameter R-39 form with 80 turns of No. 28 double-silk-covered wire, tapped 30 turns from the bottom. Condenser C26 has a variable range from 4 mmfd. to 70 mmfd.

The use of a separate beat-frequency oscillator is definitely superior to an attempt to autodyne by introducing regeneration in the intermediate-frequency amplifier. While this oscillator is primarily intended for the beat-note reception of code signals, it is of considerable assistance in the location of television and 'phone stations, and as an indication of frequency modulation or drift.

With the exception of the type –27 second detector and the pentode output tubes, the tubes indicated are all type –24's. However, there is no reason why the series types –36-7-8 battery tubes cannot be substituted if it is desired to operate the receiver from a d.c. source.

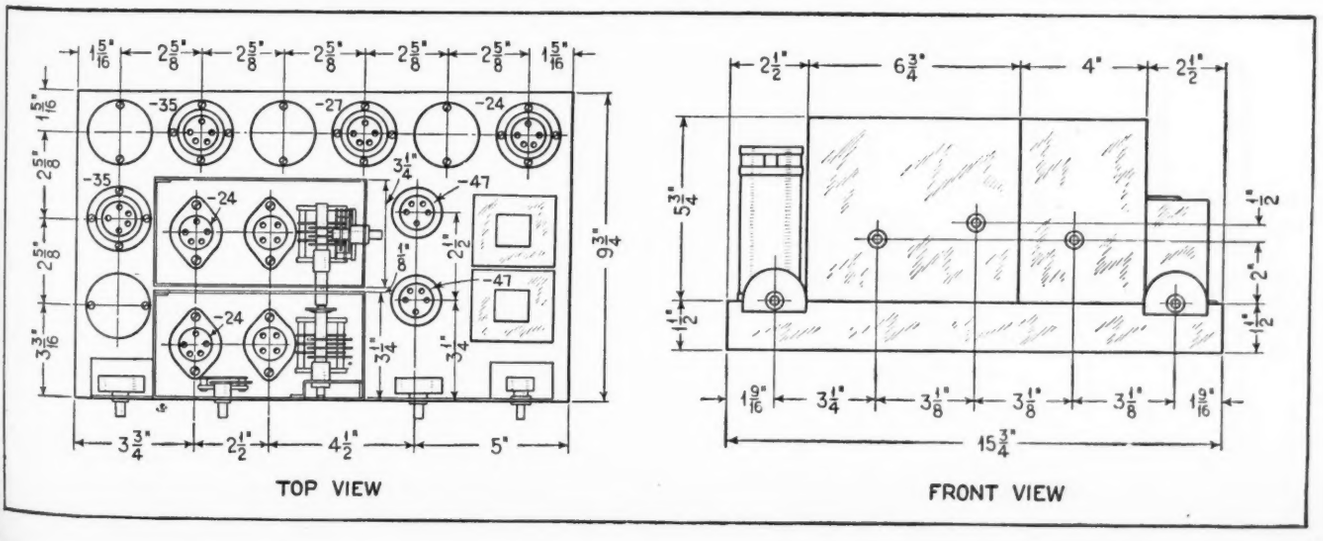
Construction Details

The mechanical requirements of the ultra-short-wave "super" are no less rigorous than the electrical specifications. The general details, suggested in the front-panel layout, Figure 2, the sub-panel layout, Figure 3, and the photographs, Figures 4, 5 and 6, should be adhered to religiously. The chassis and shields must be rigid and conform closely to the indicated dimensions. The recommended layout has been engineered to provide the shortest practical leads between the signal-frequency components of the circuit. The importance of this will be appreciated when it is considered that the total length of wire on a 5-meter coil is approximately 5 inches. The high-frequency wiring should be rigid and, at the same time, highly damped, to reduce the tendency to vibrate. Low-loss parts, such as described in the previous articles of this series and recommended herein, should be employed throughout.

Particular attention has been devoted to the location and connection of by-pass condensers in an effort to reduce regeneration in the intermediate-frequency amplifier. Even a small amount of regeneration will result in a characteristic hiss and a high noise level. Best results will be obtained when the grounded terminals of all by-pass condensers in the i.f. circuit are grounded to a single point on the (*Continued on page* 127)

EXACT CONSTRUCTIONAL DETAILS

Figure 3. At left: Gives the exact location of all the parts on the sub-panel, as shown in Figure 4. Figure 2, right: Gives other constructional data, as well as supplying the drilling details for the front panel



HINTS ON DESIGN AND INSTALLATION OF AUTOMOBILE RADIO

This timely discussion of the problems encountered in auto radio installation work will answer many questions in the minds of those who are making, selling, installing or servicing automobile receivers

By **M. J. Sheedy**

Part One

IT is a recognized fact that there are various localities where radio reception is very poor. These "dead spots" vary from a few hundred feet to several miles. It can be seen, therefore, that in the course of several hours' travel some adverse conditions will be met. In order to reduce the effects of these dead spots to a minimum, a highly sensitive receiver and an efficient antenna system are required.

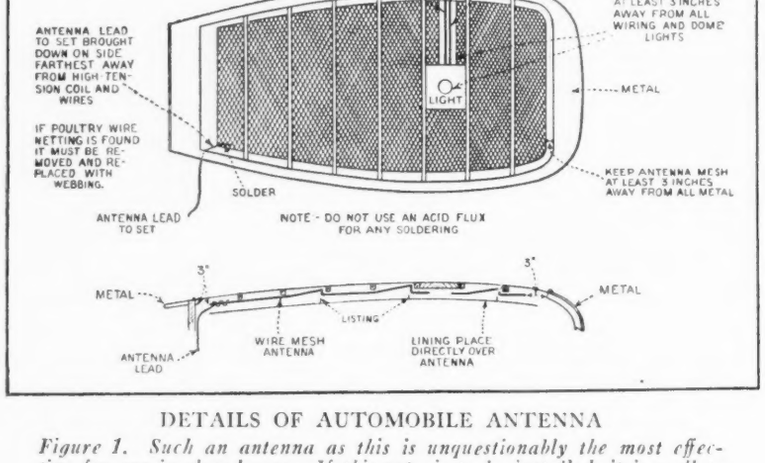
Hints on Receiver Design

Now the car's ignition system constitutes an extremely broad transmitter, and the receiver is invariably mounted within both the electrostatic and electromagnetic fields of this transmitter. The higher we raise the sensitivity of the receiver, therefore, the higher we raise the level of interference from the ignition system. Mounting suppressors on the spark plugs reduces this interference to some extent, but in most cases not enough. This condition will not interfere with reception in the vicinity of strong local stations, but in the case of weak signals the interference may be sufficient to demodulate the broadcast carrier and ruin reception. Thus there is established a very definite relationship between signal level and noise level, which must be given thoughtful consideration in designing the receiver.

The limitations of the power supply and the number of tubes which can be used necessitates getting the maximum efficiency from what we have. To experimenters who wish to build their own, the following pointers are given:

All tuned circuits must be carefully matched and balanced within very narrow limits. All leads should be as short as possible. The tuning condensers should be small and rugged and equipped with pigtail connections. Some s.l.f. condensers, due to the large radius of unsupported metal from the shaft to the tip of the rotor plates, have a tendency to vibrate at high motor speeds. This has the effect of modulating the incoming carrier and results in a microphonic sound. When choosing condensers this should be borne in mind.

Coils should be treated with lacquer to make them moisture-proof. Close coupling should be used, if possible, for maximum transfer of energy. No flux of any kind except rosin should be used in soldering, and all wiring of any length should be laced down. The complete receiver should be housed in a weather-proof container so designed that, when mounted, the receiver will be accessible for service. All external wiring should be properly shielded and grounded.



DETAILS OF AUTOMOBILE ANTENNA

Figure 1. Such an antenna as this is unquestionably the most effective for use in closed cars. If this type is to be installed, it is well to employ the services of an experienced upholsterer to take down and replace the roof lining fabric

It must be borne in mind that the equipment will be subject to various extremes of climatic conditions—heat, cold, dampness and condensation. For this reason only a reliable make of B battery should be used. Cheap batteries will not give proper service under these conditions.

Due to the varying character of receiving conditions encountered while traveling, an automatic volume control is important if the signal is to be kept approximately at a predetermined level.

Cars that are engineered at the factory for radio have the type of antenna shown in Figure 1. In cars not so equipped it is generally more feasible to use the plate antenna mounted below the chassis or running-boards. Except for superheterodynes, the top antenna is preferable for greater pick-up, even though the installation of one may require the services of an upholsterer.

Some sets on the market are designed for the top antenna and others for the plate antenna. If an antenna is used other than the one for which the set was designed, the balance of the antenna circuit should be carefully checked with an oscillator. There is a great difference in the characteristics of these two types of antennas. This difference is sometimes greater than can be compensated for, especially at the ends of the scale, by the small trimmer condensers.

In a case of this kind it may be necessary to balance the circuit by either adding or subtracting one or two turns on the coil or by changing the capacity of the antenna series condenser, if one is used.

Ignition Interference

We now come to the problem of ignition interference. We will analyze a simple ignition circuit and see how to eliminate the effects of its operation.

The intensity and causes of interference vary in different makes of cars and even in individual cars of the same make. The degree of success achieved in its elimination will depend on the ingenuity of the serviceman and his knowledge of the laws of magnetic induction.

In Figure 2a, we have a simple set-up consisting of a circuit breaker, distributor, ignition coil and spark plug. When the breaker point is closed, current flows through the ignition coil primary, building up a magnetic field and at the same time charging the primary condenser C1. The opening of the breaker points causes this field to collapse, accompanied by the discharge of the primary condenser.

This action causes an induced current to be set up in the secondary winding which, due to the step-up ratio of the coil,

is of sufficient value to jump across the gap in the spark-plug. The ignition wires, due to their length, have a certain amount of inductance and, as they run practically parallel to the motor block, they have capacity to ground. Thus we have the equivalent circuit of Figure 2b.

Due to this inherent capacity (Cx) and inductance (Lx) of the system and the action of the spark-plug, we have, to all practical purposes, a closed oscillatory circuit.

When this cycle of operation takes place, a definite portion of the total current will be of an oscillatory nature. This results in the radiation of a very broad wave train having a high decrement and rich in harmonics. While this wave train is relatively weak, it is nevertheless of sufficient amplitude to be picked up and amplified by the near-by receiver.

Noise Frequency

The frequency of this wave train is, of course, controlled by the constants of the circuit; i.e., the inductance and capacity of the high-tension system. Consequently, this interference is more noticeable on the low end of the scale. This will also explain why superheterodynes with specially designed intermediate transformers are not quite so susceptible to this disturbance as receivers of the t.r.f. type.

As the length and relative position of the high-tension leads differ, the frequency of the wave radiated by the individual leads must differ. The effects of this radiation in a multi-cylinder motor at high speed can be easily imagined. My reason for bringing out this fact is to show the futility of trying to tune the ignition system beyond the range of the receiver—a method which has been tried on aircraft without success.

Our first point of attack on this source of interference is to neutralize the high-frequency radiation of the system. The most obvious solution is to damp out the small alternating currents without materially affecting the larger direct-current component. This theory is responsible for the development of the suppressor.

Suppressor Installation

These suppressors have a resistance of about twenty-five thousand ohms. Less than this will not be effective for our purpose, while a greater resistance will affect the operation of the motor. The suppressor should be mounted on the spark-plug so as to be as close to the seat of the trouble as possible. A suppressor should also be inserted in the center lead of the distributor head. This is to take care of the rotor gap. Some servicemen make the error of mounting it at the coil. Its effectiveness is lost in this position.

Along with this type of interference there is an impact voltage set up in the antenna. This is caused by the sparking of the breaker points, distributor and the remaining d.c. arc across the plugs. This voltage is undirectional, and its frequency is whatever the receiver happens to be tuned to at the time. This effect is called free oscillation and is readily detected.

In a receiver with a reasonably flat response curve it will be heard with equal amplitude over the full scale. When a broadcast carrier is tuned in, this type of interference will generally increase, while the first-mentioned type will decrease.

Another disturbing factor is voltage surges in the low-tension wiring of the car. There is always a tertiary or kick-back voltage set up in the primary circuit of the ignition coil. At the moment the circuit is broken this voltage may be much higher than the impressed voltage.

There are two paths open for the return of this current to ground, one through the breaker-point condenser, C1, the other through the storage battery. C1 is of small capacity and offers some resistance. If we allow it to return through the battery it will spread throughout the whole low-tension system. To by-pass this current to ground, we connect a 1 microfarad condenser between the battery side of the coil and ground, as at C2, Figure 2b, thus effectively by-passing the trouble.

These disturbances, either collectively or individually, manifest themselves in various other ways also. The most important of which is the setting up of standing waves and eddy currents in various parts of the body structure, in cushion springs and metal floor boards. Another is the setting up of induced currents in adjacent low-tension wires; *i.e.*, light and horn wires, etc. These wires, running to various parts of the car, carry this induced current into the electrostatic field of the antenna.

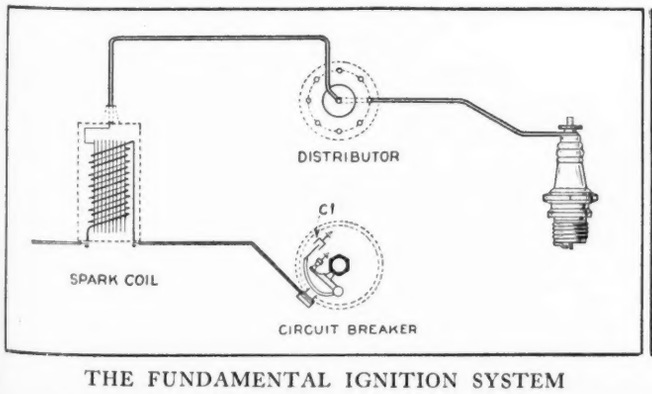
Standing waves are something that the serviceman cannot do very much to eliminate. This condition is more noticeable in custom-built bodies and bodies of the convertible type. The principle offenders are floating panel sections and upholstery springs. To illustrate an incident, on one make of low-price car the robe rail and cushion springs in the back of the front seat had to be bonded and grounded to get quiet reception.

Induced currents and stray fields, however, can be eliminated by segregation. In a number of cars, some low-tension wires are run in conduit with the high-tension wiring. In other cars, the breaker and battery wires of the ignition coil may be bunched into a fabric-covered cable with horn and light wires. These wires must be separated and rerouted.

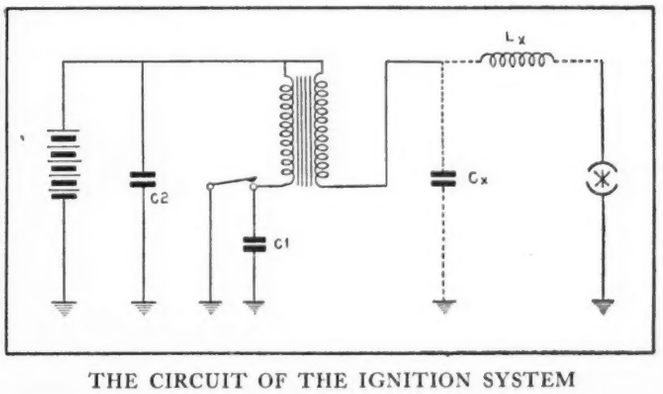
Quite a number of cars have the ignition coil mounted directly back of the instrument board. In this case, it may be necessary to place a metal shield (*Continued on page* 121)

RUGGED CONSTRUCTION ESSENTIAL

This new R. C. A. Victor auto radio chassis is a good example of the strong construction and complete protection required to insure good results and freedom from trouble



THE FUNDAMENTAL IGNITION SYSTEM



THE CIRCUIT OF THE IGNITION SYSTEM

Figure 2a. Left—The high tension wiring shown by the heavy lines is the main source of ignition noise. Figure 2b. Right—The ignition system is the equivalent of a miniature spark transmitter, the high tension lead to the spark gap serving as an oscillating circuit by virtue of its inherent capacity and inductance, as indicated by Cx and Lx

New

Tuned R.F. Design

FOR SHORT-WAVE RECEPTION

The new r.f. pentodes offer big possibilities for short-wave receivers of the tuned r.f. type, as exemplified in this latest addition to a long line of rightfully popular receivers

By Zeh Bouck

THE general tendency toward the superheterodyne in broadcast receiver design has been thoroughly justified by the development of sets meeting the present-day requirement for selectivity at a price that it would be difficult to approach with another system of reception attaining equal results. Probably in the most general interpretation of efficiency—results obtained for dollars spent—the super is without rival in the broadcast band between 1500 kc. and 550 kc. The excellence of the superheterodyne on frequencies higher than those of the conventional broadcast band cannot be denied, but the development of new tubes which greatly enhance the effectiveness of the tuned r.f. system, and several characteristics of the super itself, react unfavorably for this receiver (with the exception of quasi-optical reception) in the general consideration of efficiency as outlined in the foregoing.

From the point of view of amplification, the superheterodyne is fundamentally an inefficient receiver, due to the fact that only about two-thirds of the tubes contribute to signal intensification. As far as amplification is concerned, the mixer or first detector, the oscillator and at least one of the tubes in the preselector may be considered about as useful as the veriform appendix. It is of course true that the tubes in the preselector circuit function as amplifiers, but it is seldom that they more than compensate the attenuation occasioned in that circuit through the attainment of image-frequency rejection. However, all these tubes contribute to background hiss and noise, which, on short waves, is already of a relatively high level due to causes beyond control. These effects can be reduced in special-purpose supers, such as are used commercially for transoceanic reception, by highly elaborate and expensive design and directional systems. But such *tours de force* are rarely available to the individual experimenter.

Also, the requirement for selectivity which so adequately justifies the superheterodyne on wavelengths above 200 meters is generally less exacting on shorter wavelengths and is definitely undesirable on television reception. Also, the frequency allocations are more judicious and the channels far less crowded. Between 200 and 600 meters there are 100 ten kc. channels. Between 10 and 200 meters there are 2850 of these ten kc. channels.

The superheterodyne was originally developed to overcome the inefficiencies accompanying radio-frequency amplification employed fifteen years ago. However, the development of various types of modern vacuum tubes gradually increased the radio-frequency efficiency of short-wave circuits, and the advent of the screen grid made possible a short-wave receiver in which satisfactory r.f. gain was achieved even below 20 meters. The new radio-frequency pentodes contribute still further to

SPECIAL R.F. CHOKE

Figure 2. Careful design of this radio-frequency choke is responsible for the elimination of body capacity effects

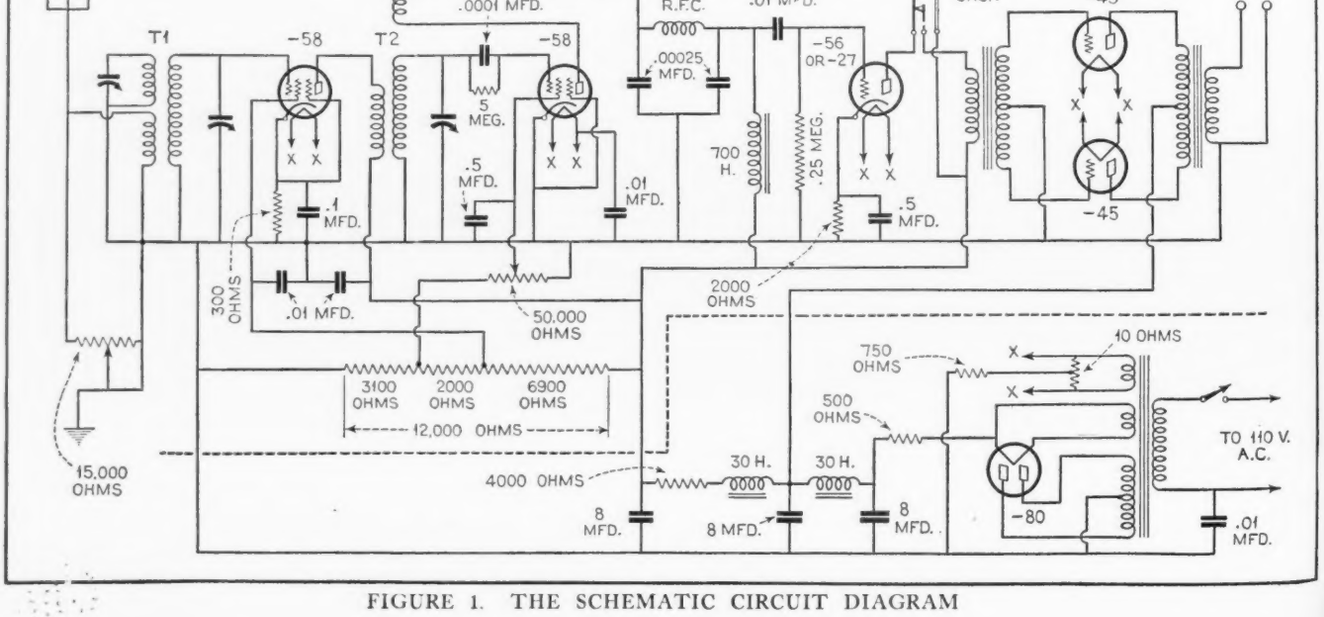
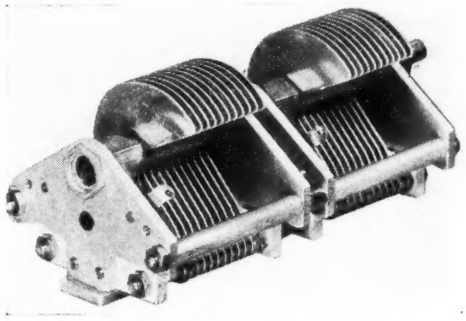


FIGURE 1. THE SCHEMATIC CIRCUIT DIAGRAM

the possibilities of the t.r.f. receiver, and the National Company design to be described in this article represents an engineering achievement comparable without apology with a high-grade short-wave super. Until something finer can be developed, this receiver is the ultimate stage in the evolution of a long line of short-wave receivers, the more familiar of which —the "Thrill Boxes," the SW-3, SW-5 and the SW-45—have been widely employed for amateur, experimental and commercial purposes.

The principal differences between the present receiver and its immediate predecessor, the SW-45, are best explained by reference to the wiring diagram, Figure 1. These are the substitution of the type -58 pentodes in the r.f. and detector circuits, the provision for radio-frequency gain control and the radio-frequency filter in the plate circuit of the detector.

The radio-frequency pentode has contributed in no small way to the high efficiency of this circuit. Its high amplification factor, transconductance and, above all, its high plate impedance, enable the designer to achieve a degree of selectivity and sensitivity that have heretofore been little more than experimental ideals. The use of these tubes naturally necessitated the redesign of the plug-in radio-frequency inductors. The primary requisite of such a transformer is to develop as high an impedance in the plate circuit as is possible. In low-frequency work, the optimum ratio between primary and secondary turns is approximately 2 to 3 and represents a compromise between sensitivity and selectivity, taking into consideration capacity, loading effects, etc. As the frequency increases, it has been found that this ratio should also increase, along with the size of the wire and the diameter of the winding. Still further variations are imposed by the r.f. pentode, the -58 having about twice the plate impedance of the -24. The coils, T1 and T2, are wound on the low-loss R-39 material and are available in various sets, covering from 12 to 200 meters, and band-spread coils can be obtained for special portions of the frequency spectrum. Additional coils can be wound, extending the range of the receiver as high as 2000 meters.



SPECIAL TUNING CONDENSER

Figure 5. The rotors on this short-wave condenser are insulated from the frame and from each other, eliminating coupling through common circuit linkage

Control of Volume

It has heretofore been considered that the simple regeneration control in the detector circuit provided adequate overall volume control. Such an arrangement, however, results in several forms of distortion. The radio-frequency tube is necessarily operating at maximum amplification at all times, resulting in considerable overload of both that tube and the detector on strong signals. Backing up the regeneration control to reduce the signal strength results in additional distortion, due to the fact that the detector tube is then being operated with decreased plate or screen voltage. The obvious solution is to employ a second control operating at the input to the r.f. stage. Under actual reception conditions, this additional control contributes several other advantages. The detector may always be operated on that portion of its characteristic at which best rectification is obtained, with a resulting improvement in tone quality and detecting efficiency. The receiver may also be operated in the condition of maximum selectivity by setting the regeneration control close to the point of oscillation and controlling volume altogether at the r.f. input. This latter feature is of particular utility in bringing in a foreign station having a frequency allocation close to that of a powerful local.

The radio-frequency filter in the detector plate circuit is the result of careful study of the problem. Few experimenters seem to realize the difficulties encountered when excessive r.f. is permitted to invade the audio-frequency circuits. The most noticeable characteristic of such a condition is the presence of hand-capacity effects on all parts of the a.f. system, including the headphones and loudspeaker leads as well as the metal cabinet. Another symptom is the exasperating fringe howl as the detector approaches oscillation. A sticky regeneration control—an apparently excessive amount of lost motion—is directly traceable in many cases to inadequate filtering in the detector output circuit.

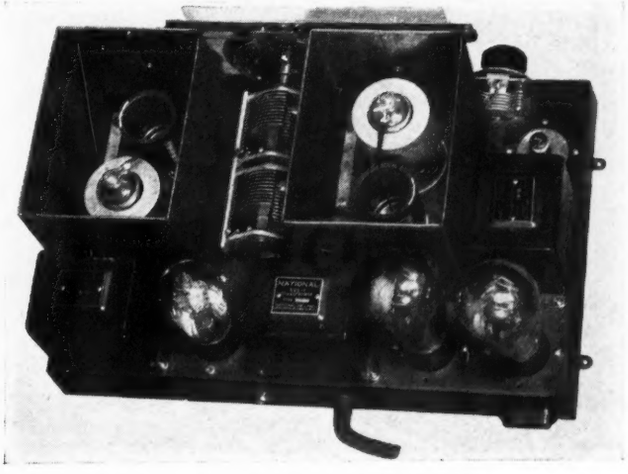
The use of a detector tube having a high plate impedance precludes the employment of a fairly large by-pass condenser, which would necessarily attenuate the higher audio frequencies, resulting in muffled tone quality and even unintelligibility of speech. The matter resolves itself into the familiar high radio-frequency problem of an efficient r.f. choke design. A choke which meets the rigid requirements of low-wave work is shown in Figure 2. As will be observed, it consists of four lattice-wound sections, spaced about 3/16 inch on an Isolantite form. The inductance is only 2½ millihenries, but, what is more important, the distributed capacity has been reduced to 1 mmfd.

Undesirable Coupling Eliminated

The remainder of the circuit is fairly conventional, and the important values are given in Figure 1. Several electrical details, however, are worthy of especial emphasis in reference to the general shielding and the design of the ganged tuning condensers. The obvious shielding between the radio-frequency and detector circuits is shown in Figure 3. However, it has been found that in the design of a single-control high-frequency receiver additional precautions must be taken to avoid coupling between the input and output circuits of the r.f. stage. Passing over the usual methods of circuit isolation, we come to a point which is often overlooked. This is the coupling through those portions of the tuned circuits which happen to be common in parts of the gang (*Continued on page* 110)

RECEIVER IN ITS METAL CABINET

Figure 4. The full-vision scale, with a pointer moving along it, is a unique and attractive feature



THE CHASSIS

Figure 3. Top view of the S.W. -58, showing the general shielding arrangement

CIRCUIT DATA AND CHARACTERISTICS OF TWO

NEW TUBES

TYPE -82

TYPE -46

The number of new tubes is still increasing steadily. This month information is presented concerning two vacuum tubes which are especially suited for use in Class B amplifiers. Sound technicians, servicemen and engineers should be interested in this data

By J. van Lienden

AN increasing demand for greater output power is responsible for the development of so-called "Class B" amplifiers. This type of circuit enables one to obtain a large amount of output power from relatively small tubes with but little distortion. Such amplifiers need a power supply which is capable of the same output voltage at varying loads. The tubes have nearly no plate current when the grids are unexcited, but at high volume levels the current may be as high as 200 milliamperes. The mercury-vapor rectifier is the best type for this kind of service.

Class B Power Amplifier, Type -46

The type -46 tube is a double-grid power amplifier designed for both Class A and Class B service. Besides the customary grid between the filament and plate, this tube has a second grid between plate and control grid. The second or outer grid should be connected to the plate for Class A service and to the control grid for Class B service. With the grids connected together, the amplification factor is so high that a negative grid bias is not required for Class B service.

When the outer grid—the one nearest the plate—is connected to the plate, the amplification factor becomes lower. The tube then is suitable for an output stage of Class A service or for the driver stage of two -46 tubes in push-pull. In that case, the control grid should be made 33 volts negative with respect to the filament. The characteristics of the tube are given in the accompanying table.

The grid of the -46 tube is driven positive for one-half cycle when it is used as a Class B amplifier. The grid then draws current, and extraordinary care must be taken in the design of the coupling system between the driver and the output stage. The transformer must deliver the power required to maintain an undistorted wave form in the secondary. For this purpose, step-down transformers are usually employed. The ratio of the primary to one-half of the secondary may range between 1.5 to 1 and 5.5 to 1.

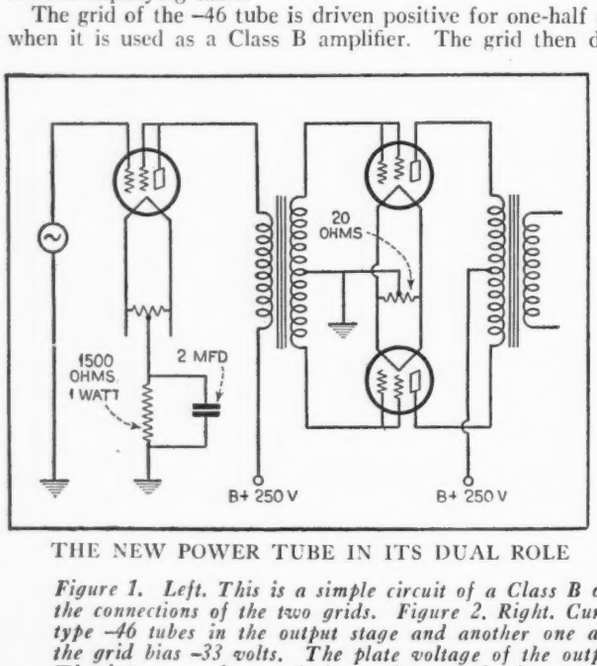
A circuit suggested for the utilization of the Class B power amplifier is shown in Figure 1. Another -46 tube, connected as a Class A amplifier, is the driver. It is important that distortion in the driver stage be minimized. Hum can be reduced by returning both plate and grid circuits to the variable mid-tap of a resistance connected across the filament terminals. The mid-tap of the output stage can be obtained from a center-tapped filament transformer or from a center-tapped resistor of 20 ohms.

The Mercury-Vapor Rectifier, Type -82

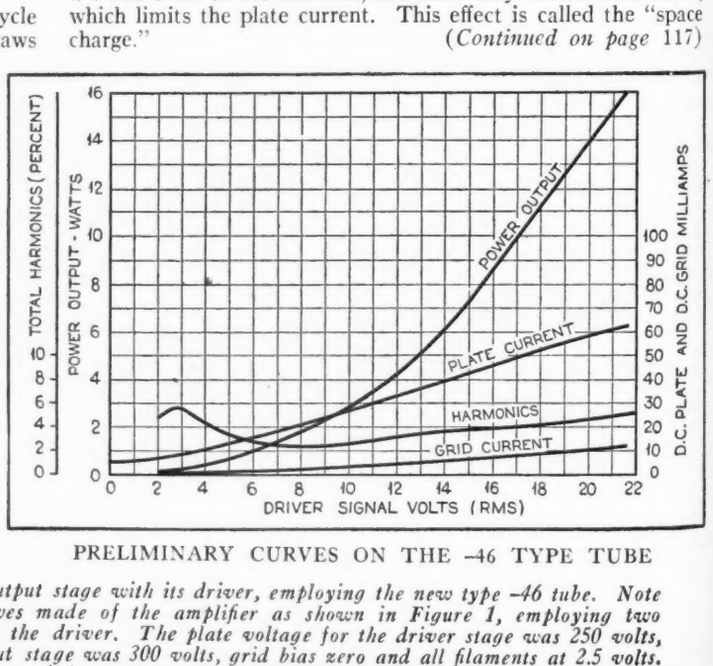
A full-wave, mercury-vapor rectifier with a 2.5-volt filament has recently been announced. This tube is for circuits which need higher regulation than the present full-wave rectifier affords.

The reason for the better regulation of a gas-filled rectifier can best be understood when we consider what happens inside the tube. The hot filament emits electrons which are attracted by the plate during half a cycle. The electrons, however, form a cloud close to the filament, and thus they retard each other, which limits the plate current. This effect is called the "space charge."

(*Continued on page* 117)



THE NEW POWER TUBE IN ITS DUAL ROLE



PRELIMINARY CURVES ON THE -46 TYPE TUBE

Figure 1. Left. This is a simple circuit of a Class B output stage with its driver, employing the new type -46 tube. Note the connections of the two grids. Figure 2. Right. Curves made of the amplifier as shown in Figure 1, employing two type -46 tubes in the output stage and another one as the driver. The plate voltage for the driver stage was 250 volts, the grid bias -33 volts. The plate voltage of the output stage was 300 volts, grid bias zero and all filaments at 2.5 volts. The input transformer had a voltage ratio from primary/½ secondary of 2.2; the peak power efficiency was 79 percent. The output load, from plate to plate, was 3500 ohms.

Radio Science Abstracts

Radio engineers, laboratory and research workers will find this department helpful in reviewing important current radio literature, books, Institute and Club proceedings and free technical booklets

Conducted by
Joseph Calcaterra

Theory of Thermionic Vacuum Tube Circuits, by L. J. Peters. McGraw-Hill Book Company, Inc., Publishers. Although this book was first published in 1927, this new printing is still the most up-to-date treatise on tube circuits available in America. The technician, the serviceman or the operator, after he has graduated from his training course, is often at a standstill. In order to advance further in his chosen field, a greater knowledge of the theory of radio circuits is essential. To such men, as well as to students and engineers, Mr. Peters' book should be of great value.

The first chapter discusses the emission of electrons from hot bodies and the conditions necessary for the electron to travel to the plate of a tube. There are chapters on elementary amplifier theory, the triode as an oscillator, the theory of radio receiving circuits, the design of amplifier circuits, and others. Each chapter is followed by questions which enable the student to test his progress on this subject. The necessary mathematics in theoretical textbooks has often frightened away many prospective students. By careful perusal of Mr. Peters' textbook, it was found that the bulk of the mathematics is only ordinary algebra of complex quantities. Once in a while there are differential equations, and although a knowledge of calculus is desirable, the student who lacks this can still benefit by a study of the work.

Drake's Cyclopedia of Radio and Electronics, 1932 Edition, by Harold P. Manly. Published by Frederick J. Drake & Co. The well-known reference book, *Drake's Radio Encyclopedia,* has been enlarged and enriched with up-to-date material on radio transmission and reception, sound pictures, public-address systems, photocells and television. Because the new subjects do not all deal with radio transmission, the word "Electronics" has been added to the title.

The book lists all technical terms in alphabetical order, defines them and explains the theory and practice in non-technical language. The material has been expanded considerably since the first edition.

The section on tubes, for instance, now covers some 108 pages. List of characteristics of all tubes are given. The tube constants are defined and their significance discussed. Such problems as impedance matching have been treated in a language the serviceman can understand. This section is sufficiently up-to-date to include the radio-frequency pentode.

Here, for instance, is the section on coils. Practical information is given on the construction of coils and chokes of different shapes. The formula is given for chokes with an air gap for different air-core coils. There are three pages of tables giving the required number of turns needed for covering the broadcast band, for different condensers, with different wire sizes and diameters of coil forms. These two examples have been given to illustrate the scope of the work. Other subjects are treated in a similar manner.

Review of Articles in the May, 1932, issue of the Proceedings of the Institute of Radio Engineers

Application of Quartz Plates to a Radio Transmitter, by O. M. Hovgaard. This paper is primarily concerned with the methods of obtaining optimum frequency stability from the quartz plate. The causes for slow variation in frequency are traced. A description is given of newly designed equipment which minimizes these variations. The improvement obtained is shown graphically.

A New Water-Cooled Power Vacuum Tube, by I. E. Mouromtseff. It is recognized that a single output tube is to be preferred above several smaller ones in parallel. This necessitates the design of tubes for ever-increasing output power. This paper is concerned with the design and construction of the Westinghouse A.W.-220 type tube for output powers of 100-300 kilowatts.

An entirely new grid construction is employed which minimizes grid and dynatron action. It consists of a water-cooled column of flat molybdenum discs. Curves are given showing the operation of the tube as Class A, B and C amplifiers.

The Vibration of Quartz Plates, by Robert Cameron Colwell. A discussion showing the similarity between vibrating quartz crystals and "Chladni" plates. Crystals, vibrating in an electric circuit, break up into segments; the segments are separated by nodal lines which can be made visible by licopodium powder.

The mathematical theory of "Chladni" plates and of electrically vibrated quartz plates is applicable to these nodal lines. Photographs of mechanically vibrated "Chladni" plates and of electrically vibrated quartz plates are reproduced to show their resemblance.

A Study of Class B and C Amplifier Tank Circuits, by Perry H. Osborn. The paper discusses the influence of the L/C ratio and the tank-circuit resistance on the output power and second harmonic distortion. Experiments were made at a frequency of 480 cycles with tubes of the type 203-A, 211 and 845.

Results obtained show that the output power is independent of the L/C ratio, but depends on the output circuit impedance. The second harmonic increases with the L/C ratio for a given output.

The Reception of Frequency-Modulated Radio Signals, by Victor J. Andrews. This paper discusses the reception of frequency-modulated signals by various adjustments of a tuned circuit. The signal is considered as a carrier and side-bands. These side-bands will cause beats in the detector which cancel each other unless the tuned circuit is adjusted to the slope of the resonance curve instead of to the peak. Maximum power response is found to be .09 of the response with an amplitude-modulated transmitter of the same power. The receiver discriminates against the lower frequencies which approxi-

mately counterbalances the discrimination against the higher frequencies at the transmitter.

Field Intensity Measurements at Frequencies from 285 to 5400 KC. per Second, by S. S. Kirby and K. A. Norton. Field intensity measurements were made of radio signals at different frequencies and at different distances from the transmitter in order to determine at which distance the absorption of the earth becomes appreciable.

The results show that measurements of radiation should be made within five wavelengths of the transmitter in order to eliminate absorption effects. Experimental data were compared with Rolfe's attenuation graphs in order to determine the electrical constants of the land in the path of the wave. The data is also compared with the Austin-Cohen transmission formula.

Phase Shift in Radio Transmitters, by W. A. Fitch. A treatment of the measurements, causes and effects of phase shift in radio transmitters. A method is described for the measurement of the angle of phase shift by means of a cathode-ray oscillograph; a shift of one degree can be detected.

Review of Contemporary Periodical Literature

Do Our Ears Grow Old? by H. C. Montgomery. Bell Laboratories Record for May, 1932. This is the result of about 200 measurements of persons, employees of the Bell Laboratories, to determine the difference in hearing acuity between young and old persons. Graphs are shown illustrating the findings.

The conclusion is that with age hearing decreases appreciably at the high frequencies only.

Sensitive Moving-Coil Microphone of High Quality, by A. L. Thuras. Bell Laboratory Record for May, 1932. The dynamic microphone was invented by Siemens in 1877; it has not been used in practice for lack of a suitable amplifier.

The article describes a new dynamic microphone with a substantially flat frequency response from 45 to 10,000 cycles. The response, it is explained, depends upon the constant velocity of the diaphragm. The velocity, in turn, is affected by the weight and stiffness of the diaphragm and the resistance of the air. An air chamber and outlet tube is used which is so designed as to offset the influence of the stiffness and weight in obtaining a constant velocity of a diaphragm.

Adapting the Moving-Coil Microphone for Commercial Use, by L. W. Giles. Bell Laboratory Record for May, 1932. A slightly different type of microphone than the one described in the previous articles was developed for commercial use. The magnetic field is supplied by a permanent magnet of cobalt steel with soft iron pole pieces.

The diaphragm is damped by an air chamber which corresponds with the outside through a small tube. The angle of incidence of the sound wave affects frequency response to a marked degree. These effects are shown graphically.

Ether Spectrum Chart. Electronics, April, 1932. A chart in full colors, showing the latest assignments of radio services by channels, as arranged under the Radio Commission's 1932 orders, is included as a supplement with this issue. This revised chart brings up to date the latest scientific determinations of wavelengths and frequencies in the fields of sound, Hertzian waves, heat rays, infra-red, visible light, ultra-violet, X-rays, Gamma rays and cosmic rays.

Radio Reception and Sunspots, by H. T. Stetson, Electronics, April, 1932. During the past few years, abstract ideas regarding the effects of sunspots or electromagnetic disturbances on the sun on radio reception have been crystallized into concrete data by a series of careful and painstaking observations. The article gives the results of laboratory tests which prove conclusively the remarkable influence of sunspots on the intensity of the signals received at a given point from a given broadcast station.

Power Detection Characteristics of Pentode Tubes, by H. A. Brown and C. T. Knipp. Electronics, April, 1932. Some interesting data on the use of pentode tubes as detectors is given which seems to indicate that the pentode tubes are exceptionally well suited for use as power detectors in the full sense of the term, since they are capable, roughly estimating, of putting out about ten times as much power as any other type of detector.

Output Amplifiers for 110-Volt D.C. Receivers, by J. R. Nelson. Electronics, April, 1932. Designers and experimenters who have been puzzled regarding the relative advantages of different types and combinations of tubes for use in the output stage of 110-volt d.c. receivers will find considerable valuable information on the tests made and conclusions reached by Mr. Nelson on this important subject.

Highlights on Electronic Devices in Industry. Electronics, April, 1932. Many new or heretofore little-known applications of electronic devices are brought to light in this special department which describes a photocell camera that guards a laboratory, a new method of guiding ships by taking soundings electronically which chart its course, a method of increasing egg production by means of ultra-violet rays, earthquake alarms and counterfeit money detector.

Free Technical Booklet Service

Through the courtesy of a group of radio manufacturers, RADIO NEWS now offers its readers this new Technical Booklet Service. By means of this service readers of RADIO NEWS will be able to obtain quickly and absolutely free of charge many interesting, instructive and valuable booklets and other literature which formerly required considerable time, effort and postage to collect.

To obtain any of the booklets listed in the following section, simply write the numbers of the books you desire on the coupon appearing at the end of this department. Be sure to print your name and address plainly and mail coupon to the Radio News Technical Booklet Service. Stocks of these booklets and catalogs are kept on hand and will be sent you promptly as long as the supply lasts. Do not send for any material in which you are not actually interested in order to avoid waste of needless postage

Review of Technical Booklets Available

1. *Micamold 1932 Catalog.* A 12-page booklet giving complete details, specifications and list prices on the line of dry electrolytic, paper, mica and replacement condensers, automobile ignition suppressors and carbon resistors.

2. *Hammarlund 1932 Catalog.* A 4-page folder which gives complete specifications and list prices on the Hammarlund line of broadcast, short-wave, transmitting and midget variable condensers, equalizing, trimming and padding adjustable condensers, sockets, coils, shields, chokes and flexible couplings.

3. *Hammarlund-Roberts 15 to 550-Meter "Comet" Superheterodyne.* A folder giving complete details of an efficient all-wave receiver, especially designed to cover the short-wave and regular broadcast channels up to 550 meters.

4. *Hammarlund-Roberts 14 to 200-Meter "Pro" Comet Superheterodyne.* A custom-built high-frequency superheterodyne receiver, designed especially for professional operators and advanced amateurs, is described in this folder. The receiver is designed for the reception of both code and voice signals and is especially suited for laboratory, newspaper, police, airport and steamship use.

5. *Electrad 1932 Catalog.* Complete specifications and list prices on the entire line of volume controls, voltage dividers, vitreous resistors, Truvolt adjustable resistors, public-address equipment, amplifiers, replacement controls and resistors are contained in this 10-page book. It also contains a chart of replacement controls and circuits and an important announcement on the Resistor Replacement Handbook.

6. *Amperite Line Voltage Control Folder.* This folder gives complete description of the characteristics and uses of the automatic regulator and explains why all leading radio manufacturers recommend its use to prevent radio trouble. A chart showing the proper unit for all the popular receivers now in use is also given.

7. *"Rich Rewards in Radio."* This 64-page book is filled with valuable and interesting information on the growth of radio and the opportunities existing in the fields of radio manufacturing, radio servicing, broadcasting, talking pictures, television, public-address systems and commercial station operation on land and sea, for men who are trained to fill the many jobs created by the radio and allied industries. The book also contains detailed information on the complete home-study courses in radio and allied subjects offered by the National Radio Institute.

8. *Trouble Shooting in D.C., A.C. and Battery Sets.* This is a free sample lesson available to RADIO NEWS readers through the courtesy of the National Radio Institute. It contains valuable information on how to overcome hum and noises of all kinds, fading signals, broad tuning, howls and oscillations, poor distance reception, distorted or muffled signals, etc.

9. *International Resistance Catalog.* A handy folder giving complete specifications and list prices of metallized and precision wire-wound resistors, motor radio suppressor kits, handy servicemen's resistor kits, etc.

10. *Information on the Suppression of*

(*Continued on page* 125)

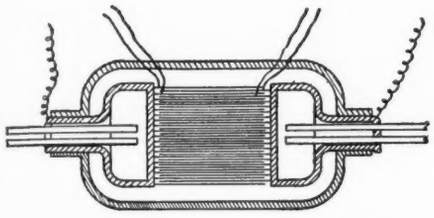
Latest Radio Patents

A description of the outstanding patented inventions on radio, television, acoustics and electronics as they are granted by the United States Patent Office. This information will be found a handy radio reference for inventors, engineers, set designers and production men in establishing the dates of record, as well as describing the important radio inventions

Conducted by

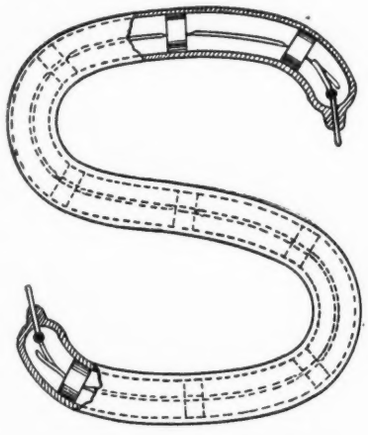
Ben J. Chromy*

1,842,797. VACUUM CONDENSER. ALEXANDER NYMAN, Dobbs Ferry, N. Y., assignor to Dublier Condenser Corporation, New York, N. Y., a Corporation of Delaware. Filed Sept. 3, 1924, Serial No. 735,572. Renewed May 26, 1931. 7 Claims.



5. The combination of a containing vessel, condenser plates of conductive material supported in spaced relation within the vessel, the supporting means for the plates being adapted to convey a cooling medium to the condenser.

1,842,525. GLOW LAMP. RALPH M. HEINTZ, Palo Alto, Calif., assignor to Heintz & Kaufman, Ltd., San Francisco, Calif., a Corporation of Nevada. Filed May 6, 1930. Serial No. 450,166. 6 Claims.



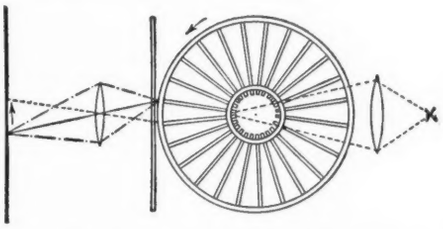
1. A glow lamp comprising a pair of wire electrodes, and insulating beads threaded upon said electrodes to maintain a substantially uniform spacing therebetween.

1,844,456. AUDION CIRCUIT. STUART BALLANTINE, White Haven, Pa., assignor to Boonton Research Corporation, Boonton, N. J., a Corporation of New Jersey. Filed Nov. 3, 1926. Serial No. 146,038. 5 Claims.

1. An electrical amplifier stage comprising an audion tube and impedance network associated therewith and arranged in the form of an alternating current Wheatstone's bridge of which the input circuit of the audion stage forms one conjugate arm and the output circuit of the audion stage forms the other conjugate arm, said bridge having two adjacent balancing arms each comprising an inductance and effectively located respectively between grid and plate of said tube and between the plate of said tube and an intermediate point of an alternating current plate-filament path thereof, and two adjacent balancing arms each having a capacitive reactance and located in the two remaining balancing-arm positions in said bridge.

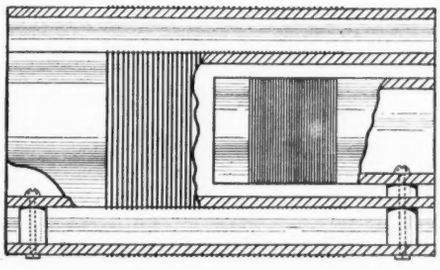
*Patent Attorney, Washington, D. C.

1,844,508. SCANNING APPARATUS AND METHOD. CHARLES FRANCIS JENKINS, Washington, D. C., assignor to Jenkins Laboratories, Washington, D. C., a Corporation of the District of Columbia. Filed Jan. 14, 1930. Serial No. 420,672. 3 Claims



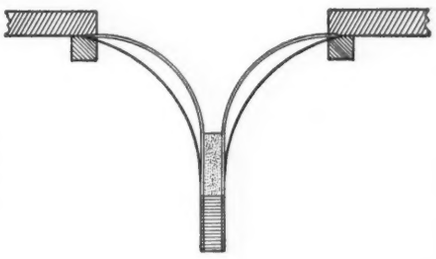
1. Scanning apparatus comprising an arc lamp, a rotary device carrying a plurality of separate light conducting rods positioned between said arc lamp and the subject or object to be scanned, means for concentrating and projecting the light from said lamp upon the inner ends of said rods in succession, and means for causing the light emerging from the outer ends of said rods to be imaged upon and to trace successive adjacent strips across the subject or object.

1,846,701. RADIO-FREQUENCY TRANSFORMER. HAROLD A. WHEELER, Jackson Heights, N. Y., assignor to Hazeltine Corporation. Original application filed June 20, 1929, Serial No. 372,275. Divided and this application filed May 28, 1930. Serial No. 456,474. 10 Claims.



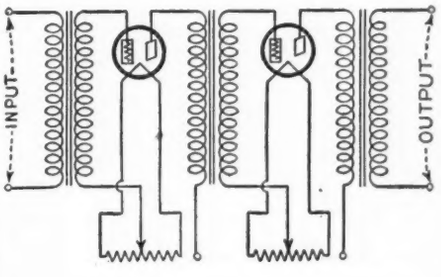
1. A transformer comprising two primary windings and a secondary winding so positioned relatively that the product of the coupling coefficients between one primary and the secondary and between the other primary and the secondary equals the coupling coefficient between the two primary windings.

1,845,584. DIAPHRAGM FOR RADIO LOUD SPEAKERS. CHARLES HUGH DUFFY, Miami, Fla. Filed Mar. 31, 1931. Serial No. 526,663. 28 Claims. (Granted under the act of Mar. 3, 1883, as amended Apr. 30, 1928; 370 O. G. 757.)



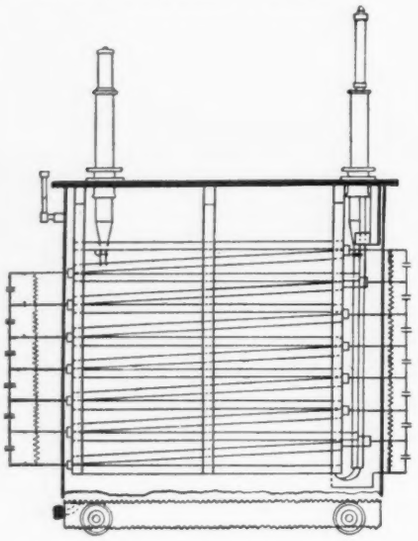
1. A diaphragm for radio loud speakers or the like of substantially partially circular formations having a central meeting portion, edge portions and end portions, the line of juncture at the central meeting portion being curved rearwardly from the ends to the center, and a positive stiffening area in rear of the line juncture of the flexed portions, said stiffening area being of a capacity sufficient to prevent whipping of the end portions and insure bodily movement of the entire central meeting portion of the two flexed portions of the diaphragm.

1,846,597. RADIO CIRCUIT AND METHOD OF OPERATING SAME. FREDERIC W. HOCHSTETTER, Pittsburgh, Pa. Filed Dec. 4, 1929. Serial No. 411,409. 2 Claims.



1. In an apparatus of the type described, the combination comprising a plurality of multi-electrode audions each including a control electrode, input and output circuits for each of said audions electrically associated to form an amplifier, means within the audion for dielectrically isolating the control electrodes of each audion to eliminate grid current flow, and means externally of the audions in the input circuits for dielectrically isolating the control electrodes.

1,842,716. HIGH VOLTAGE RECTIFICATION. VINCENT ZIANI DE FERRANTI, Hollinwood, England, assignor to Ferranti Inc., New York, N. Y. Filed Sept. 11, 1929, Serial No. 391,903, and in Great Britain Oct. 12, 1928. 6 Claims.

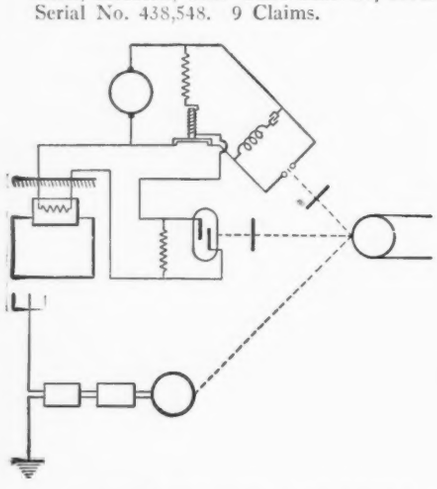


1. A high voltage rectifier comprising a plurality of sections disposed in zigzag fashion and immersed in a suitable insulating material, each section embodying plurality of elements of the copper oxide type electrically connected in zigzag fashion.

1,839,634. CONVERTER. MILTON ALDEN. Springfield, Mass., assignor, by mesne assignments, to Radio Inventions, Inc., a Corporation of New York. Filed Jan. 26, 1928. Serial No. 249,685. 20 Claims.

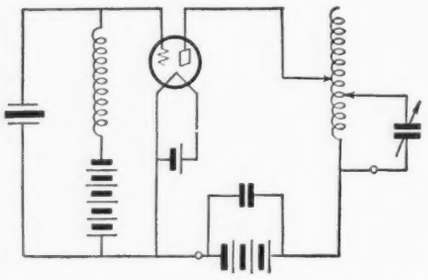
8. A radio set connector comprising an insulating base having projecting prongs for insertion into the socket of a direct current set, contacts mounted within said base, two of which are connected to two of said prongs, external terminals extending from an edge of said base and connected to the other contacts in said base, and a third external terminal projecting from an edge of said base and connected to two of the prongs, said base having passages for the insertion of tube pins to said contacts, and a resistance supported from some of said terminals and connected between the same.

1,842,968. SEISMOGRAPH. SEPP HORVATH, Houston, Tex. Filed Mar. 24, 1930. Serial No. 438,548. 9 Claims.



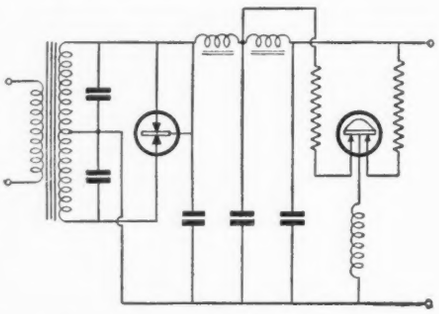
1. In combination with an electrical impulse receiving set, a condenser adapted to change in capacity in proportion to mechanical vibrations, a pair of tuned circuits, said condenser being connected in one of said circuits whereby said circuit will be detuned by said condenser, and means to record the degree of detuning of said circuit.

1,848,630. PIEZO-ELECTRIC CRYSTAL. EDWARD O. HULBURT, Washington, D. C. Filed Dec. 23, 1925. Serial No. 77,404. Renewed Aug. 5, 1931. 5 Claims.



1. A piezo-electric crystal, metallic films deposited on the surfaces of said crystal, said films each adhering intimately to said crystal and having a thickness proportioned to the natural frequency of the unloaded crystal and the desired frequency of the loaded crystal for selectively fixing the frequency of operation of said crystal.

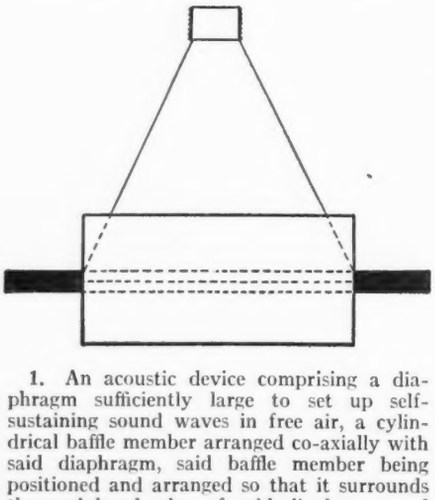
1,844,977. VOLTAGE REGULATOR. DELBERT E. REPLOGLE, Jersey City, N. J., assignor to Raytheon Inc., Cambridge, Mass.,



a Corporation of Massachusetts. Filed Mar. 20, 1928. Serial No. 263,179. Renewed Dec. 17, 1930. 5 Claims.

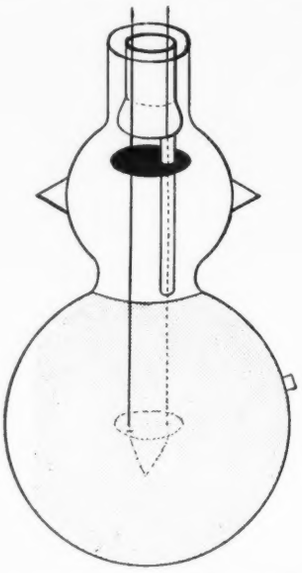
5. In a voltage regulating system a source of direct current, a load fed by said source, a glow discharge tube, and an inductance in series therewith across said load.

1,844,014. ACOUSTIC INSTRUMENT. ALFRED AUBYN LINSELL, Brentwood, England, assignor to Radio Corporation of America, a Corporation of Delaware. Filed July 13, 1928, Serial No. 292,444, and in Great Britain Aug. 30, 1927. 3 Claims.



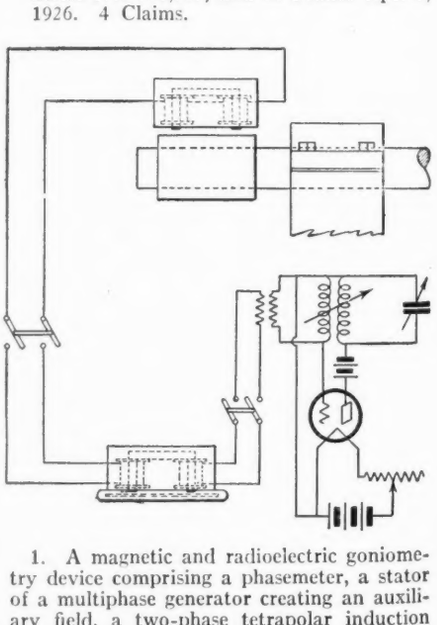
1. An acoustic device comprising a diaphragm sufficiently large to set up self-sustaining sound waves in free air, a cylindrical baffle member arranged co-axially with said diaphragm, said baffle member being positioned and arranged so that it surrounds the peripheral edge of said diaphragm and so that the peripheral edge of said diaphragm is immediately adjacent a circle on said cylindrical member intermediate the ends thereof, and a non-planar reflecting surface positioned immediately in back of said diaphragm so as to reflect the sound waves set up by the rear of the diaphragm.

1,843,728. PHOTO-ELECTRIC TUBE. HARRY F. MESICK, Jr., Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. Filed Sept. 27, 1928. Serial No. 308,715. 3 Claims.

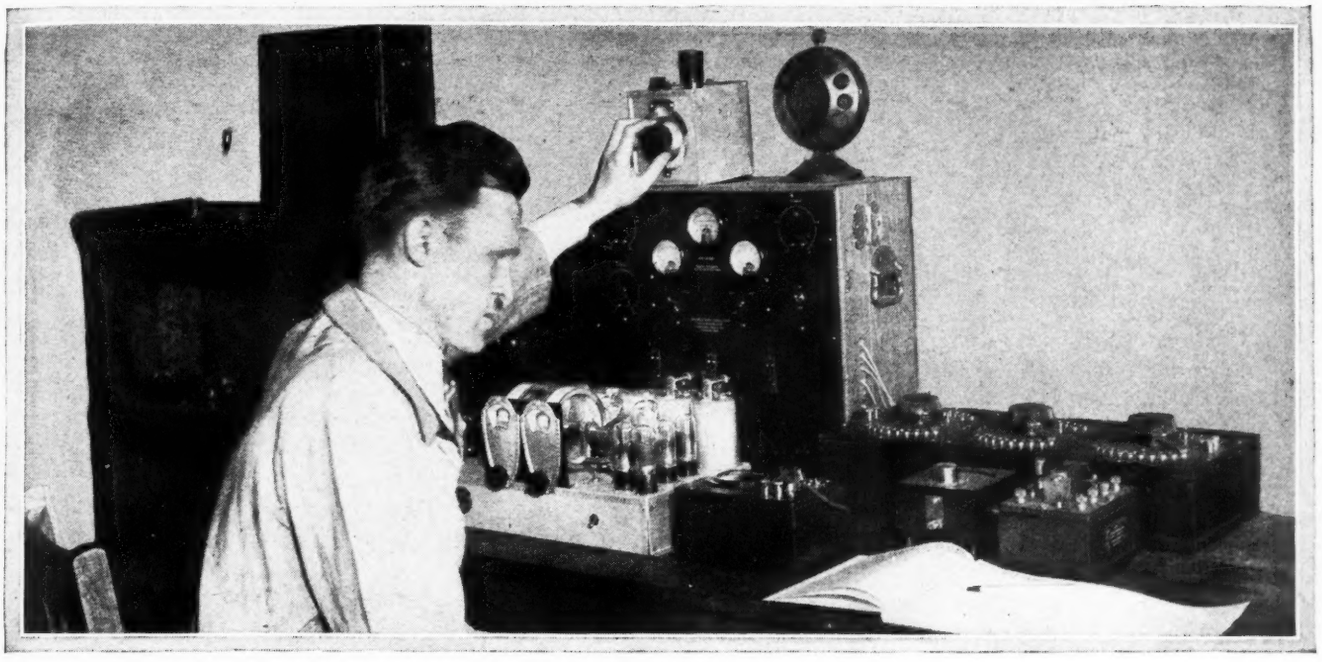


1. In combination, a light-sensitive device comprising a receptacle, a pair of electrodes mounted therein, one of said electrodes being capable of emitting electrons under the influence of light and a metal member mounted in said receptacle and coated with finely divided carbon.

1,844,859. MAGNETIC AND RADIO-ELECTRIC GONIOMETRY. LUCIEN LEVY, Paris, France. Filed Apr. 1, 1927, Serial No. 180,319, and in France Apr. 3, 1926. 4 Claims.



1. A magnetic and radioelectric goniometry device comprising a phasemeter, a stator of a multiphase generator creating an auxiliary field, a two-phase tetrapolar induction rotor in this field, an exploring element for the field in observation, said element and said rotor rotating together, and means to compare in said phasemeter the relative phases of the electromotive forces generated respectively in said rotor and in the exploring element.



With the Experimenters

Experiments in Static Reduction, Accessible Plug-in Coils, Effective Indoor Antenna, Bending Copper Tubing, Transmitter Remote Control, Simple Ground Clamp, Hint for Temporary Wiring, Home-made Mallet; DX'ers Corner—World Radio Reception Club, Tips on DX Tuning, Headphone Kink

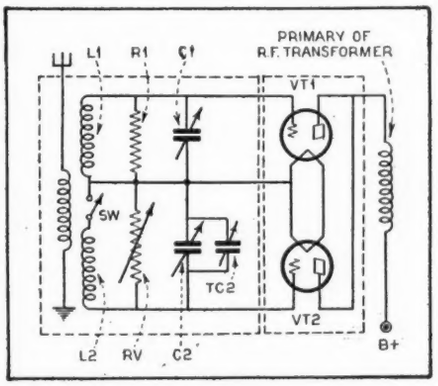
Conducted by

S. Gordon Taylor

Experiments in Static Reduction

IT has always been my luck to live in a neighborhood that was more than liberally blessed with interference of all kinds, and so from time to time the problem of static reduction has come up. Early in the game the antenna shunts and trick trap circuits were given up.

Next I began experimenting with push-pull radio-frequency amplification and finally devised the interference-reducing hook-up shown herewith. This circuit gave very good results and I still use a modification of it. The circuit of L1, C1 receives the incoming desired signal and also the normal static or interference. The resistor R1 is shunted across the circuit in order to make sure that the voltage developed across L2, C2 will be higher than the voltage across L1, C1. Circuit L2, C2 is tuned to a slightly different frequency than circuit L1, C1. The static and interference comes in through both tubes and the signal through VT1 only. As the plates are in parallel and the grids in push-pull, any impulse applied to both grids will be neutralized in the plate circuit while an impulse applied to one grid only will be passed on to the rest of the set. A signal, therefore, may enter through either tube, and so the trimmer TC2 is used to tune circuit C2, L2 to a frequency as close to the one that it is desired to receive as possible without tuning to the frequency of another station. The variable resistor Rv is used to balance the input to VT2 so that it will be exactly the same as the input to VT1 and will therefore balance out the latter. By throwing switch SW, the set becomes a conventional tuned radio set. By closing the switch, the balancing tube is in the circuit and almost instant comparisons can be made. Using this arrangement and other modifications of the same idea, I have been able repeatedly to receive medium distant stations at a time when it was almost impossible to receive local stations with the



switch thrown to the conventional side, due to local interference. Using a shielded superheterodyne with two types -51 tubes in the r.f. balancing stage, I have obtained very good results.

EARL STOWELL,
Long Beach, Calif.

Mr. Stowell's idea seems practical and should offer interesting possibilities for experimentation. The editor of this department will be glad to hear from readers who try out this circuit. While the principle employed is not a new one, it is one which has the advantage of simplicity.

Accessible Plug-In Coils

The usual practice has been to mount short-wave plug-in coils inside the receiver cabinet. This necessitates raising the lid of the cabinet to remove the plug-in coil, and if the contact pins of the plug-in coil stick, the whole receiver will be almost jerked from the operating table. Also, it is often difficult to locate the prong holes in the socket when a coil is being inserted, due to poor lighting and the awkward position of the operator when leaning over the receiver. To overcome these features, the following described method of panel mounting was worked out.

To keep from having to dismantle and rebuild a receiver then in use, the writer shopped around among the radio stores until he found an old battery model receiver costing $2.00. This receiver was then dismantled and redesigned.

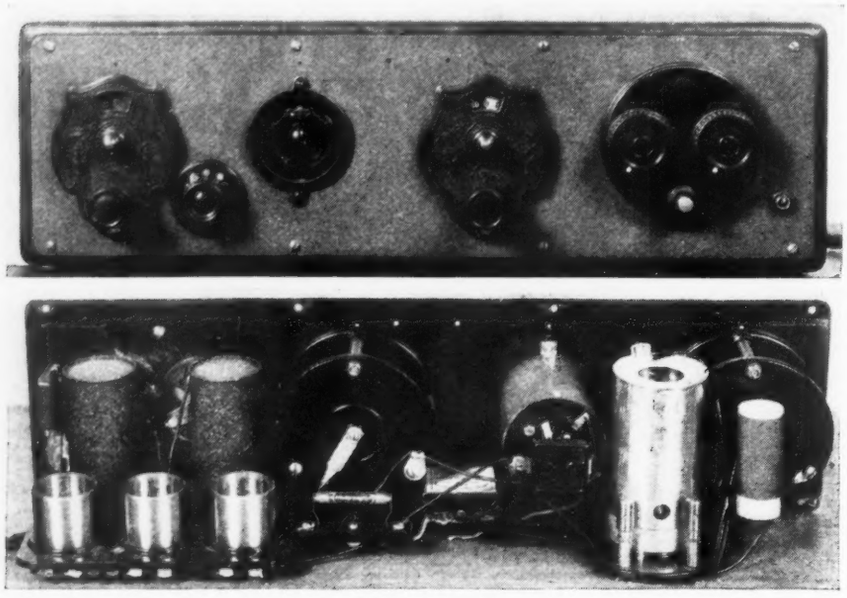
First, a hole was cut in the metal panel two and one-fourth inches in diameter. Next, a piece of one-sixteenth-inch wall bakelite tubing, two and three-eighths inches outside diameter and three and one-fourth inches long, was procured. This was for the well, which holds the coil socket assembly and which also acts as a dust shield, keeping dust from creeping into the receiver around the coil opening in the panel.

From a scrap piece of three-sixteenths-inch hard-rubber panel the socket mounting ring and the bezel were cut. The mounting ring should fit snugly inside the near end of bakelite tubing, where it is secured by three bolts. The hole in its center should be large enough to take a five-prong tube socket.

The bezel should measure two inches inside diameter, and two and one-half inches outside diameter, having two ears to accom-

modate the panel-mounting bolts.

As will be seen from the back view, the bakelite well or sleeve is held up against the panel by two small brass brackets, which fit



the two holes holding the bezel in position.

Hand-capacity effect is not noticed in the operation of the receiver unless the hand is placed directly over the coil opening in the panel. However, if the panel used is not metal, it is advisable to shield behind it to prevent hand-capacity effects. The shield need be only about five inches in diameter, circular in shape, with a hole cut in the center equal to the outside diameter of the socket-mounting sleeve. Of course, the shield must be connected to ground or negative filament.

To remove the plug-in coil (one of the Pilot type) it is only necessary to place the thumb against the panel, hook the finger through the coil ring and pull. When the coil is replaced, the opening being on about the same level with the operator's eyes, it is a very easy matter to mesh the coil pins with the socket and thus place the plug-in coil in position.

WM. G. WHEAT,
Kansas City, Mo.

Bending Copper Tubing

When a copper tube is bent or wound into a coil, it will always flatten at the bends. This trouble can easily be overcome by filling the tube with resin.

One end of the tube is stopped up with a wad of cloth or paper and the tube held with the open end up. The melted resin is then poured from a ladle, with the aid of a funnel, completely filling the tube. If a long piece of tubing is being filled, it is a good plan to warm the tube by running a flame along it a few times to make sure the resin does not harden before it has run all the way down.

When the resin has hardened, the tube can be bent in any shape. Then heat it up and run the resin out.

WM. K. WEBB,
Caledonia, Ontario, Can.

Where there is sand available, it may be used in place of the resin. Simply fill the tubing with sand, then allow some water to run down into the tube to pack the sand. Drain off surplus water, seal the ends of the tubing by flattening, and make the necessary bends. When dried the sand can be run out.
—The Editor.

Transmitter Remote Control

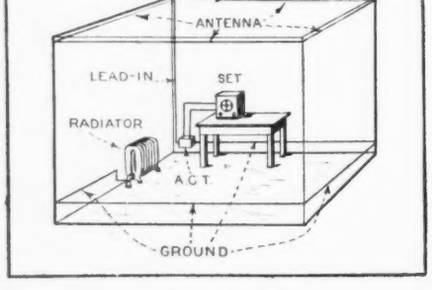
Herewith is a method for the remote control of a radio transmitter using a single circuit between the transmitter and the location of operation. By having two relays at the transmitter connected in series with each other and the remote-control line, it is possible to have one of them throw the power line on to the transmitter and the other to be used for keying. At the operating point a key in series with a battery is connected across the control line. The battery may be the six-volt supply used to light the fila-

(*Continued on next page*)

Effective Indoor Antenna

I have a little suggestion to those who are not able to have an outside antenna. The sort of inside antenna shown herewith gives good results on all frequencies. For s.w. reception it is very good, as I have heard 12RO, Rome; FYA, Paris; G5SW, Chelmsford, England; and Königswusterhausen, Germany, with impressive clarity and volume.

For antenna and ground wires I use a very flexible and soft wire which can be obtained in the 25-cent stores, length 65 feet. The antenna wire I string around the ceiling and



lead it to the antenna-coupling transformer (ACT). The ground wire I string around the floor; one end I ground to the radiator and the other end to the antenna-coupling transformer. The antenna-coupling transformer has two wires, and here you have to test which wire to attach to the antenna post of the set and the other one to the ground terminal. For antenna-coupling transformer I use the multiple antenna-coupler made by the Insuline Corporation. I find that this antenna will give much better results than many poorly erected outside antennas.

H. P. SCOTT,
Waterbury, Conn.

DX'ers Corner

World Radio Reception Club

Your stand in promoting a DX'ers corner in RADIO NEWS is to be commended. I have long been looking for such a development, as the trend with present-day powerful receivers seems to be again toward the DX angle of radio. Enclosed is a form letter describing our organization. We will welcome inquiries from readers concerning our club and its activities.

In addition to hearing from any and all DX'ers, we would especially like to hear from the "Super DX'ers" whose logs show 700 stations and up, and who have verifications of transoceanic reception in the broadcast band. Our aim is to secure as many as possible of this type DX'er in the club, with the express purpose of arranging special courtesy programs from stations all over the world and assuring such stations of at least some reports from club members, weather permitting and conditions being favorable at the time of transmission. We already have several well-known DX'ers in our ranks whose logs show up to 1300 stations—all broadcast-band reception.

JOSEPH STOKES,
President.

The form letter mentioned by Mr. Stokes reviews the objects of the World Radio Reception Club, explains its activity and provides rather complete information for those who may be interested in obtaining membership.

This club has approximately 300 members at the present time, the membership being open to all DX enthusiasts. Certificates are offered to those showing verified reception of 500 or more stations and special certificates to those whose logs include verified reception of distant foreign stations. Membership fees are nominal, amounting to only $1.00 per year. These fees apparently cover the cost of club stationery, a supply of which is provided for each member for use in obtaining verifications, etc.

Any reader interested in this club may obtain complete information by addressing the World Radio Reception Club at 7318 Woodlawn Avenue, Swissvale Station, Pittsburgh, Pennsylvania.

—The Editor.

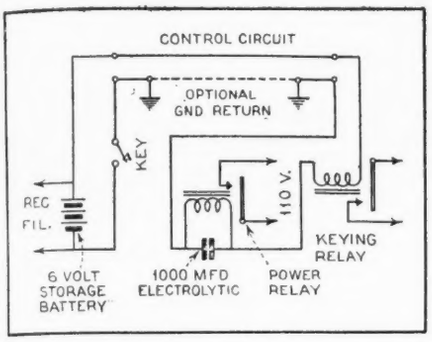
Tips on DX Broadcast Reception

Using a very sensitive two-tube receiver which I built myself, I have succeeded in tuning in regular broadcast-band stations from all corners of the earth. With this set I have heard stations located in Osaka, Japan; Rome, Italy; Buenos Aires, Argentina; St. John's, Newfoundland; Montevideo, Uruguay; Honolulu, Hawaii; Sydney, Australia; Christ Church, New Zealand; Wellington, New Zealand; Hamilton, Bermuda; Melbourne, Australia; Rockhampton and Brisbane, Australia; San Salvador, Salvador, and others. All stations mentioned have been specifically confirmed in letters from the stations.

In this article I will give a few tips on just how my reception was made possible.

(*Continued on next page*)

ments of the receiver. A high-capacity electrolytic condenser with a 15-volt rating and a capacity in the order of 1000 microfarads is connected in shunt with the relay used to control the power line. The power relay should be light-moving and high-resistance.

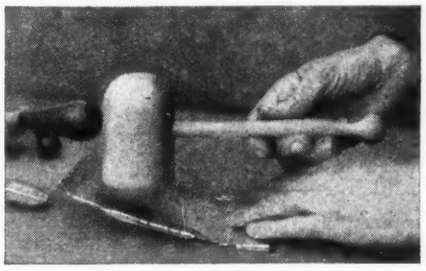


When the operating key is pushed down and held, the capacity across the power relay charges and furnishes current for holding the relay upon releasing the key. Operation may then be carried on in a regular manner, the keying relay following the dots and dashes of the key, and the power relay remaining closed unless the key is left up long enough.

KENNETH ROCKWELL,
Syracuse, N. Y.

Home-made Mallet

Around the home workbench one often needs a small, light mallet to straighten out pieces of soft material which cannot be worked with the larger, heavier chisel mallet. Not a hard job to make one if the shop is well equipped, but this is frequently not the case. Make one of an inexpensive hard-

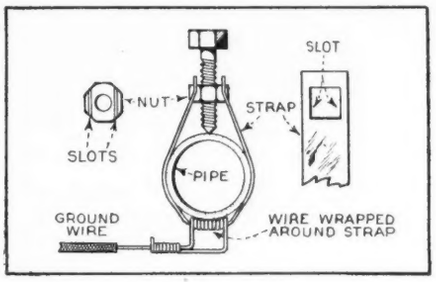


wood potato masher, which can be bought for ten cents. Cut the handle off and smooth up the round or top portion. Drill a hole an inch or so deep in the head and refit the handle as shown.

FRANK W. BENTLEY, JR.,
Missouri Valley, Iowa.

Simple Ground Clamp

The drawing needs little explanation, the strap being cut from scrap copper or even an empty smoking tobacco can. The nut may be slotted with a hacksaw so that the slots are about one-half as deep as the nut is thick.

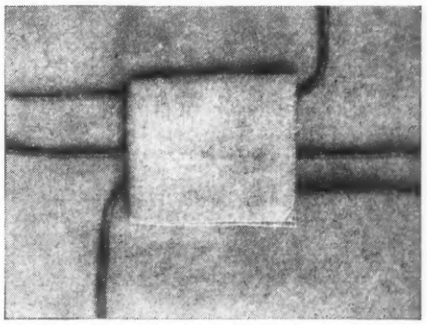


The bolt is to be tapered to a point on one end as shown, to help make a better ground, and will also aid whole clamp to set on pipe firmly.

HOWARD CHANDLER,
Ravenna, Ohio.

Temporary Wiring Hint

Around the experimental bench one very often wishes to temporarily fasten or hold a number of small wires, or keep them together to keep track of them. Take a piece of corrugated cardboard, as shown, and slip the wires through the corrugations between



the heavier holding pieces. The piece of cardboard can be glued or tacked temporarily to almost any smooth or thin surface. Any number of wires can be held or located in this simple, practical manner just where you want them to be handy to see and adjust.

FRANK W. BENTLEY, JR.,
Missouri Valley, Iowa.

DX'ers Corner

(*Continued from page* 108)

Foreign reception on the broadcast band—the channels between 1550 and 550 kilocycles—is practically impossible without a good aerial and ground system. My aerial is 55 feet above the ground, and free from tin roofs or other metal masses. The length is 150 feet, including the lead-in. I find that a longer aerial may give more volume, but the selectivity of the receiver is cut down so much that the slight increase in volume does not warrant the increased length. The lead-in is kept away from large metal masses, such as tin roofs, and as well away from walls as posible. My ground is made up of three ten-foot pipes, buried wire and buried copper plates, all connected together. All the metal is buried in rock salt, which tends to hold moisture and provides a better electrical contact. In both my aerial and ground all connections are soldered, taped and painted.

In tuning for foreign broadcast-band stations, many things must be considered that would be minor in successful tuning for United States stations. For instance, before I hope to tune in Australia, I must consider the month of the year and the exact hours of the day. I found that stations below the equator come in best during the months of October and April—or, in other words, during the spring and fall. The reason for this is that during these particular months both the points of transmission and reception are favored with rather cool weather—a necessity for good reception. Due to time difference, a station in Australia will not come through here in the United States before about four a.m. E.S.T. In fact, all trans-Pacific reception from such countries as Japan, New Zealand and Australia is accomplished between four a.m., E.S.T., and daybreak. Four a.m., E.S.T., corresponds to seven p.m. the previous day in Sydney—thus it is seen that we must wait until it is dark in Australia before we can tune in their broadcast-band stations. Among the most heard trans-Pacific stations are the following, and I suggest that readers try for them before attempting to bring in others: 4GQ, Brisbane, 760 kc.; 2BL, Sydney, 855 kc.; 2YA, Wellington, 750 kc. (same wave as WGN); and JOIK, Sappora, Japan. At present there are eight ten-thousand-watt stations in Japan, and these are heard quite frequently on the Pacific coast. The Australian stations only have about three thousand watts.

Tuning for Europe and South America is more difficult, despite the fact that they are nearer than are the stations across the Pacific. This variation in reception is caused by the time difference between these countries and the United States. Europe is five to six hours ahead of our time, thus they sign off with their evening programs before it gets dark here in the States. As for South America, their time is about the same as ours, and their stations are on at the same time as our locals, which makes them extremely difficult to bring in.

Although theoretically it should work out, reception of the early morning broadcasts of the European and South American stations is rather unsuccessful. This has and can be done, however.

Now considering United States reception. As West Chester is in eastern Pennsylvania, my best continental catches are those stations on the Pacific coast. I have learned that reception of small stations—those of 100 watts power or less—is usually accomplished after midnight. Between this hour and daybreak thousands of DX'ers are twirling the dials for these small stations that can only be picked up when on a very early morning test program or when giving a DX program for the listeners. I have heard a 100-watt station in every state that contains a station of that low a power, and a total of 63 stations in the four Pacific coast states (counting British Columbia). Like my foreign reception, these too are confirmed in letters from the stations.

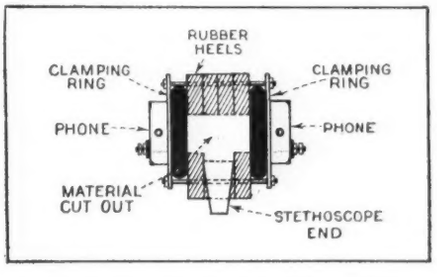
GEORGE LILLEY,
West Chester, Pa.

As a special service to the RADIO NEWS, *Mr. Lilley will personally answer queries concerning his reception, but suggests that ten cents in money or stamps be included to cover return mailing expenses. Address all letters to George Lilley, 227 West Bernard Street, West Chester, Pennsylvania.*

—The Editor.

Headphone Kink

For DX listeners the kink illustrated here will be found to make quiet reception as the stethoscope will reduce local noise a great deal; also the stethoscope itself has some amplification, due to its internal structure.



Referring to the sketch, it will be noted that only two threaded rods are used between each clamping ring, though four or six should be used so that the headphones may be clamped on tight, making the whole unit firm.

HOWARD CHANDLER,
Ravenna, Ohio.

Tuned R.F. Design

(*Continued from page* 101)

condenser frame. While the paths involved are very short, an inch or so represents an appreciable part of the total conductor length at frequencies above 15 megacycles, and is sufficient to cause instability and circuit interlocking.

To overcome this trouble, the special tuning condenser shown in Figure 5 was developed, in which both rotors are entirely insulated from the condenser frame and from each other. This design makes it possible to isolate completely the input and output circuits of the radio-frequency stage, resulting in a perfectly stable system even at the highest frequencies to which the receiver will tune.

Despite the increasing tendency toward unitary design with built-in power supply, the receiver under consideration is constructed for use with a separate power pack. Single unit construction necessitates a large amount of shielding in the r.f. and detector circuits for the elimination of hum, and this excessive shielding, in order to be effective, must be of a different nature than that which amply fulfills the r.f. isolation requirements. Shielding, at best, is a costly nuisance which tends to offset the increased efficiency attained through the use of low loss insulation and careful design. These considerations strongly recommend the use of the separate unit with a high-frequency receiver, limiting the shielding to radio-frequency fields.

The mechanical details of the receiver are fairly obvious from the accompanying photographs. Rigidity in the radio-frequency circuits is obtained through the judicious use of Isolantite and R-39 supports and mountings. In the design of the dial, consideration was given to the concensus of opinion among several hundred amateurs and experimenters who favored a full vision or open scale arrangement. The dial has a scale seven inches long, insuring accuracy in reading. The pointer moves horizontally across the entire length in a linear relationship to the tuning control.

The controls shown in Figure 4 are, from left to right, antenna trimmer, radio-frequency volume control, tuning, and regeneration.

Modern "Super" Design

(*Continued from page* 94)

supply power to the –45 Class A output stage, which will draw a fraction of a milliampere grid current when it is turning out over 4 watts output. It is largely this driver stage that enables eight to ten watts to be gotten out of a pair of –45s, which would be normally rated at 3 to 4 watts output. The driver stage presents no unusual features except its method of resistor by-passing. It is biased by the voltage drop across a portion of the main voltage divider, and instead of the usual large audio by-pass condenser, has only a .004 mfd. condenser joining the cathode to a fairly "raw a.c." point of the filter circuit. This is a carefully worked out hum-balancing system which operates beautifully in practice.

The –45 Class A output stage is not unusual in circuit, but is operated at 70 volts bias and 300 volts plate potential. It is fed by the –56 driver through a very low-resistance transformer having a 1.28:1 step-down ratio. The secondary resistance being

(*Continued on page* 117)

Portable Sound Meter

(*Continued from page* 89)

Before calibration, the filament current of the amplifier must be adjusted to the normal value. A filament rheostat is provided on the front of the sound meter panel, evident in Figure 5, and the output meter may be used to measure the filament current by the operation of a key. The shunt associated with this meter is designed so that with normal filament current a mid-scale reading is obtained. When the battery voltages are within their normal limits calibration once a day is sufficient for most work.

Experimental models of the sound meter have been available for only about a year, but already a number of important uses for the meter have been found. In the laboratories, measurements of room noise in offices and shops, noise produced by the operation of machine switching dials and by fans for telephone booths have been made.

Outside the laboratories the sound meter has been extensively used in measurements of street noise, room noise in telephone operating rooms, and noise due to various types of machinery. It has also been of service in determining the suitability of different types of warning signals in the presence of various amounts of background noise. The sound meter has also been employed extensively by the Acoustic Consulting Department of Electrical Research Products, Inc., for determining the distribution of sound energy throughout large rooms such as theatres and lecture halls; in setting up optimum sound levels in recording and broadcasting work; in determining the value of sound insulating and sound absorbing materials for reducing noise, and in the control of uniformity of manufactured products for which quietness is important.

Radio News Technical Information Service

The Technical Information Service has been carried on for many years by the technical staff of RADIO NEWS. Its primary purpose is to give helpful information to those readers who run across technical problems in their work or hobby which they are not able to solve without assistance. The service has grown to such large proportions that it is now advisable to outline and regulate activities so that information desired may come to our readers accurately, adequately and promptly.

Long, rambling letters containing requests that are vague or on a subject that is unanswerable, take up so large a portion of the staff's working time that legitimate questions may pile up in such quantities as to cause a delay that seriously hinders the promptness of reply. To eliminate this waste of time and the period of waiting, that sometimes occurs to our readers as a consequence, the following list of simple rules *must* be observed in making requests for information. Readers will help themselves by abiding by these rules.

Preparation of Requests

1. Limit each request for information to a single subject.
2. In a request for information, include any data that will aid us in assisting in answering. If the request relates to apparatus described in RADIO NEWS, state the issue, page number, title of article and the name of the device or apparatus.
3. Write only on one side of your paper.
4. Pin the coupon to your request.

The service is directed specifically at the problems of the radio serviceman, engineer, mechanic, experimenter, set builder, student and amateur, but is open to all classes of readers as well.

All questions from subscribers to RADIO NEWS will be answered free of charge, provided they comply with the regulations here set forth. All questions will be answered by mail and not through the editorial columns of the magazine, or by telephone. When possible, requests for information will be answered by referring to articles in past issues of the magazine that contain the desired information. For this reason it is advisable to keep RADIO NEWS as a radio reference.

Complete information about sets described in other publications cannot be given, although readers will be referred to other sources of information whenever possible. The staff cannot undertake to design special circuits, receivers, equipment or installations. The staff cannot service receivers or test any radio apparatus. Wiring diagrams of commercial receivers cannot be supplied, but where we have published them in RADIO NEWS, a reference will be given to past isues. Comparisons between various kinds of receivers or manufactured apparatus cannot be made.

Only those requests will be given consideration that are accompanied by the current month's coupon below, accurately filled out.

AUGUST, 1932

Technical Information Coupon
RADIO NEWS Laboratory
222 W. 39th Street
New York, N. Y.

Gentlemen:

Kindly supply me with complete information on the attached question:

☐ **I am a regular subscriber to RADIO NEWS, and I understand this information will be sent me free of charge.**

☐ **I am not yet a subscriber to RADIO NEWS.**

☐ **I wish to become a subscriber to RADIO NEWS, and enclose $2.50 to receive the magazine regularly for one year, and to receive this valuable technical information service free of charge.**

Name.....

Address.....

The "Little Chum" Portable

(*Continued from page 87*)

Cabinet

The cabinet or carrying case is constructed of ¼-inch three-ply wood, as shown in Figure 4, and is shellacked inside and covered outside with imitation leather. The cover should be lined on the inside with cloth or some kind of decorative paper. The hinges are of the kind that slip apart to permit removal of the cover when the set is being used. A spring lock and a set of rubber feet complete the cabinet equipment.

Ventilation is provided by cutting the panel smaller than the inside dimensions of the cabinet and equalizing the space around the panel so that air can circulate freely. Sufficient space is provided in the cover to carry a pair of headphones and a short antenna.

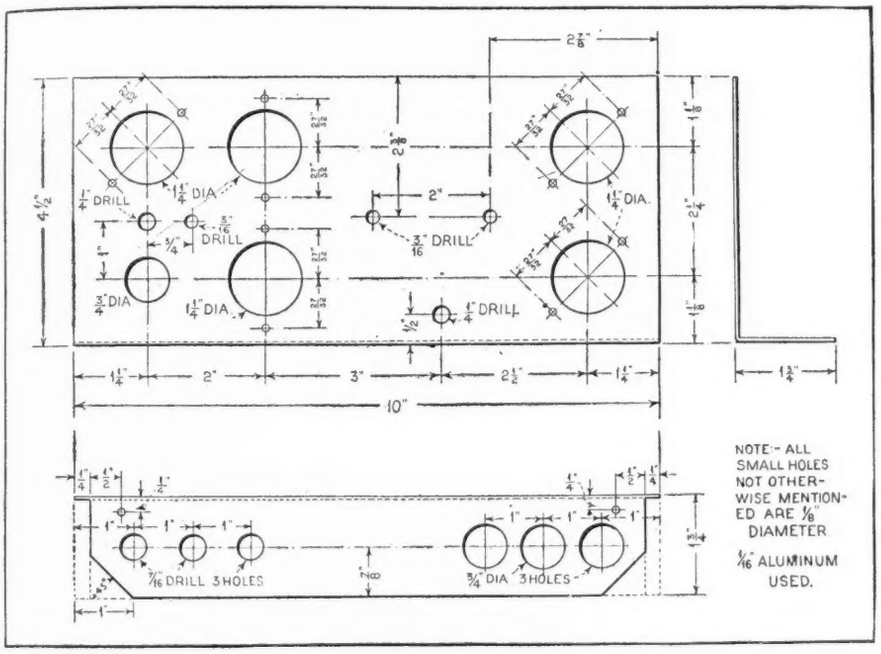


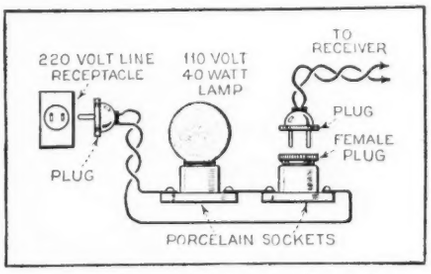
Figure 3. The Complete Chassis Specifications

Operation

Operation of the receiver is quite simple. Connect the antenna to the antenna binding post. Insert the line plug into a d.c. or a.c. receptacle served by a 100 to 130-volt line. Throw the toggle switch to the "on" position. See that the pilot lamp lights, and if it does, advance the volume control to the right in a clockwise direction, connect the phones and wait a few seconds for the tubes to heat, then tune for a station. If the service is direct current, the plug may have to be reversed in the receptacle before the receiver will function.

The trimmer condensers are used to compensate for any variation in capacity or inductance between the two tuned circuits. These are adjusted by means of the two slotted hexagon screws located at the right-hand side of the tuning condenser. Tune in a station having a weak signal, and preferably one heard near the minimum capacity setting of the tuning condenser. With a screwdriver or a small open wrench adjust the two trimmer condensers by turning each screw in and out until the point of maximum volume is found. It is always desirable to balance the trimmer condensers as near their minimum capacity position as possible in order to permit the receiver to be tuned to the lower wavelengths.

After the trimmers have been adjusted, the receiver may be put into the cabinet by sliding the projecting ends of the metal chassis into the grooves inside the cabinet provided for the purpose and securing it into place by means of four wood screws inserted through the corner holes of the panel and screwing them into the ends of the corner blocks of the cabinet.



FOR OPERATION FROM 220-VOLT LINE

Figure 5. A 40-watt lamp, connected in series with the "Little Chum" receiver permits operation from a 220-volt supply line

220-Volt Operation

This receiver may be operated from a 220-volt line by inserting a 110-volt, 40-watt lamp in series with it, as shown in Figure 5.

List of Parts

C1, C2—DeJur type 3502 two-gang, .00035 mfd. counterclockwise condensers with ⅜-inch shaft
C3, C4, C5, C6—Polymet .1 mfd. tubular condensers
C7—.001 moulded mica condenser
C8—Polymet 8 mfd. inverted type electrolytic condenser
J1, J2—Tip jacks
L1, L2—Automatic Winding Co. r.f. coils (Blan, type AW-2)
PL—3.8-volt flashlight bulb
R1—Trutest 500-ohm carbon pig-tail resistor, 1 watt
R2—Electrad 25,000-ohm variable resistor
R3—Electrad 100-ohm flexible resistor
R4—Trutest 20,000-ohm carbon pig-tail resistor, 1 watt
R5—Trutest 250,000-ohm carbon pig-tail resistor, 1 watt
R6—Electrad 300-ohm, 50-watt resistor
SW—Toggle switch, s.p.s.t.
T—Kenyon audio transformer (Blan, type K)
VT1—Type –39 tube
VT2—Type –36 tube
VT3—Type –37 tube
1 DeJur full-vision vernier dial, type STLBC, with escutcheon plate and pilot lamp receptacle
1 Blan panel, type LC, ¼-inch, 3-ply wood, size 9½ inches by 6¾ inches
1 Blan cabinet, type LC, as illustrated
1 Blan aluminum chassis, type LC, cut and drilled
3 Eby UY type wafer sockets
1 antenna binding post
1 large brown bakelite knob
1 small brown bakelite knob
6 feet lamp cord
1 receptacle plug
2 grid clips
10 ½-inch, 6/32 screws
20 6/32 hexagon nuts
6 solder lugs
1 length varnished tubing
1 foot shielded wire
2 rubber grommets for ¼-inch hole
1 roll hook-up wire
4 ¾-inch No. 6 round-head wood screws
1 4½-inch by 3/16-inch bolt and nut
2 ½-inch-diameter fiber washers
4 ¼-inch No. 3 round-head wood screws
1 ½-inch No. 8-32 oval-head screw
1 No. 8-32 hexagon nut
2 ½-inch No. 10-32 round-head screws
2 No. 10 lock washers
2 1¼-inch by 3/16-inch stove bolts with nuts
2 ½-inch spacers with 3/16-inch hole

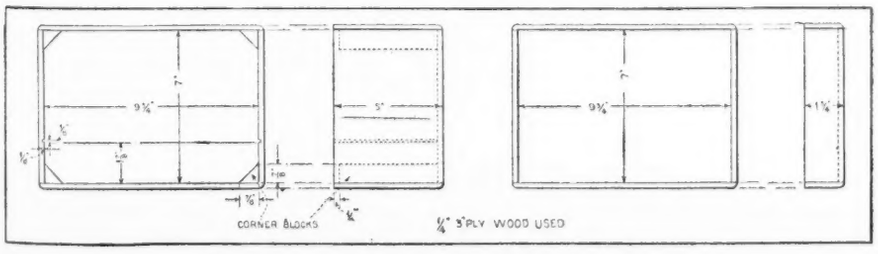


Figure 4. Specifications for the Carrying Case

Brunswick Replacements

The United Radio Service Company of New York City announce that they are now exclusive Service Replacement Parts Bureau for Brunswick radio receivers and complete service equipment at 619 West 54th Street. All models of Brunswick sets and replacement parts will be handled for servicing by this institution.

Backstage in R

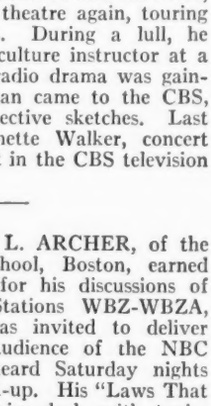
Chatty bits of news on what is happening before the microphone

By Samuel Kaufman

TED BERGMAN

TED BERGMAN, the CBS performer portraying the title rôle in the "Joe Palooka" series, came to radio after viewing life in the alternate rôles of athlete, actor, scholar, stage manager, candy merchant and deck-hand. He is twenty-five years old and a native New Yorker. He appeared in school plays and spent his vacations as a deck-hand on ocean liners. He subsequently joined a stock company and his first job took him to Oklahoma City. This venture lasted three weeks. He then appeared in several plays with the Provincetown Players. Bergman later managed productions of the Playwright's Theatre. He also toured vaudeville with Harry Green, the comedian. During his theatrical experiences, Bergman saved some money and invested it in candy which he sold to confection stands. Business was good until the hot weather ruined his stock, and he turned to the theatre again, touring with stock companies. During a lull, he worked as a physical culture instructor at a New York club. As radio drama was gaining popularity, Bergman came to the CBS, first appearing in detective sketches. Last April he married Finette Walker, concert soprano, whom he met in the CBS television studio.

DEAN GLEASON L. ARCHER, of the Suffolk Law School, Boston, earned widespread attention for his discussions of legal subjects over Stations WBZ-WBZA, Boston, before he was invited to deliver them to the wider audience of the NBC chain. He is now heard Saturday nights over an extensive hook-up. His "Laws That Safeguard Society" series deals with topics of vital interest to the average layman. Dean Archer was born in a small Maine hamlet in 1880. He did odd jobs around mills and logging lodges in his early boyhood and, at thirteen, became cook for one of the lumbering camps. He studied at night and, at an age when most boys start college, he entered high school. During his spare time he worked on a stock farm, in the hay fields, edited a country paper and taught in a rural school. He entered Boston College and won his law degree in the Class of 1906. In September of that year he founded the Suffolk Law School. Nine students reported to Dean Archer on the opening day in a modest Boston apartment. Today the institution is one of the largest law schools in America.



DEAN ARCHER

THREE noted stars of the Great White Way are featured on the new Canada Dry series heard Monday nights over the NBC. They are George Olsen, dance orchestra conductor; Ethel Shutta (Mrs. George Olsen), songster, and Jack Benny, stage and screen star. Olsen's long radio career has been interspersed with musical comedy appearances. Ethel Shutta has been featured with Olsen in theatrical and night club performances. Jack Benny is best known for his master-of-ceremonies rôle in musical shows and vaudeville. He was featured in several of the early talking pictures when musical plots were the vogue. Olsen's orchestra gained wide radio fame when it was featured in broadcasts from the Hotel Pennsylvania in New York.

ETHEL SHUTTA

ED WYNN, whose buffonery and comic antics have made him a favorite in the theatre for thirty years, has heeded the call of radio and is now in the ranks of regular microphone performers. As "The Fire Chief" in an NBC series sponsored by the Texas Company, Wynn's Tuesday night broadcasts are among the funniest things on the air. The comedian, unlike many other stage performers, scored a big hit on his first broadcast. The cast of the program includes Graham McNamee, Don Voorhees and his 35-piece band, and a "double quartet" of eight male voices. McNamee has a full-time part in this series, playing a straight lead opposite Wynn. The programs are broadcast from the Times Square studios.

Broadcasting

Personal interviews with broadcast artists and executives

ED WYNN

Wynn performed at the identical location eighteen years ago when the auditorium housed Ziegfeld's Midnight Frolic.

TOM TERRIS, long popular to movie-goers as "The Vagabond Director" in a series of travel pictures, is now featured on WOR as "The Vagabond Adventurer," Sunday nights, under the sponsorship of the United States Lines. Terriss's life has been crowded with unusual adventures. After two years at sea, Terriss worked in a Colorado silver mine. Searching for some stray horses one bitter night, he fell over a cliff when he became snow-blind. He was rescued by a party of miners and eventually recovered from severe injuries. He sailed for his native England and fell overboard in the middle of the Atlantic. Aid came just as his strength was leaving him. When twenty-one years old, he joined a stock company as an extra in "Hamlet." On the opening night he got caught on the curtain and was hoisted in the air. Thus his stage career came to an abrupt halt. He has traveled all over the world, making motion pictures, and has accumulated countless adventure stories which he unravels in a gripping and convincing manner.

TOM TERRISS

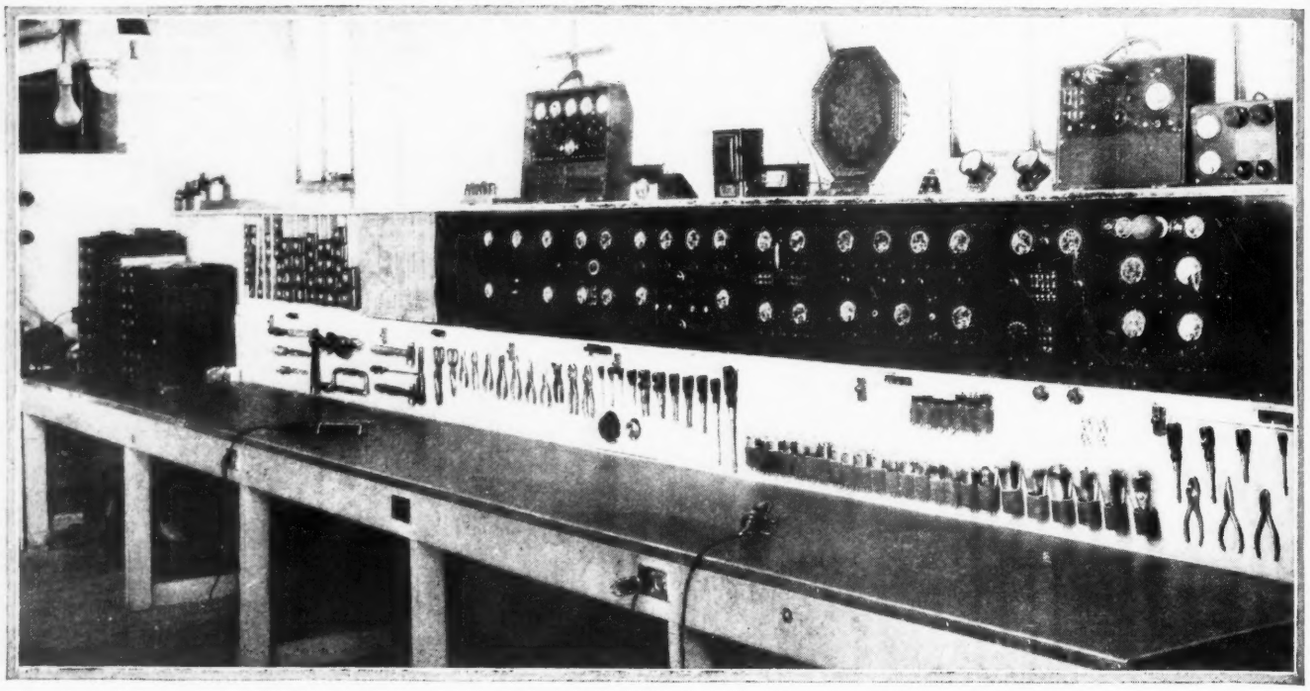
THE fifteenth series of summer concerts by the Goldman Band, under the direction of Edwin Franko Goldman, occupies prominent spots on the NBC schedule, with several concerts being broadcast over an extensive hook-up each week. The outdoor concerts originate on the Mall of Central Park and the campus of New York University, both in New York City. Goldman's radio career started with popular broadcasting itself. His first microphone appearance was over Station WJZ when that transmitter was located in Newark, New Jersey. He has been heard frequently over the air ever since. Goldman is as well known for his compositions as for his conducting. His noted marches have been heard on numerous air programs. Audiences of 15,000 to 20,000 persons attend each of the Goldman Band's summer concerts. Del Staigers, featured in past seasons, is once again the cornet soloist. From time to time prominent vocal soloists are heard on the programs.

THE National Association of Broadcasters, representing stations in all parts of the United States, recently made an arrangement with the American Society of Composers, Authors and Publishers to negotiate on the problem of fees to be paid by stations for broadcasting copyright music. It was hoped that a working basis satisfactory to both interests would be reached by September 1. The negotiations were arranged following the announcement by the Society that stations would have to increase their former annual payments of approximately $1,000,000 by $3,000,000 to $4,000,000. The higher rate was originally intended to be effective June 1, but, due to the negotiations, the Society has suspended its demands until September 1, unless an accord is reached before that date.

DAVE SCHOOLER, former master of ceremonies at the Capitol Theatre, New York, is now featured over the NBC Sunday evenings in a program known as Dave Schooler's Music Shop. Schooler appears with a 16-piece orchestra, presenting a potpourri of fast dance rhythms and symphonic effects. Four vocalists are also featured. Schooler frequently changes his radio rôle from that of conductor to that of pianist or vocalist. He pioneered in the introduction of stage orchestras to vaudeville theatres in the Middle West. He has made extensive vaudeville tours and was booked at the Capitol Theatre for two years, during which time he was frequently heard on Major Edward Bowes' Capitol "Family" broadcasts.

E. F. GOLDMAN

A DISTINGUISHED musical jury consisting of Walter Damrosch, Tullio Sarrafin, Nikolai Sokoloff, Frederick Stock and Leopold Stokowski recently selected five manuscripts from a total (*Continued on page* 117)



The Service Bench

Summer Sales—Light-Sensitive Equipment—The Service Letterhead—Service Publicity—Service Shops—Service Procedure—Rates and Charges

Conducted by
Zeh Bouck

WITH the increased merchandising possibilities in radio and closely allied fields, the summer radio servicing slump assumes a less and less practical significance. RADIO NEWS has consistently suggested summer revenues, and the comments and additional recommendations of our readers indicate that while Old Man Depression may not actually be on the run, he is at least showing his heels.

Where an appreciable summer decline exists, it provides the serviceman with an opportunity to prepare for the early fall business by stocking up on radio receivers now being sold at rock-bottom prices by large organizations.

Throughout the country the more prominent department, sporting-goods and radio stores have bought up vast stocks of complete receivers, the manufacture of which has been discontinued for various reasons, in no way reflecting upon the excellence of the sets. These receivers were acquired at a price which makes it possible for such stores to resell them at figures representing only a fraction of their actual worth. High-grade console receivers, originally listing for over $100, are bringing $39.50—or less. The prices scale down the line to under $20.00 for really good mantel-type or midget sets.

WHILE the football season, and even the world series games are still some distance off, it is time for the serviceman to consider how he can capitalize on these nationally patronized sports. The armchair bleacherites will be legion this September, and millions will enjoy depression football via the loudspeaker. And don't forget the national political campaign. This all means new tubes, minor and major servicing for the serviceman who is on the alert.

—The Service Editor.

The wide-awake serviceman will be justified in investing a few hundred dollars in such receivers on the probability of a profitable resale at a price that is still an excellent bargain for the customer. Off-hand, it might seem that this is hardly fair to the ultimate purchaser, who could have bought the set at the same price the serviceman pays for it. However, the serviceman who knows his business appreciates the intrinsic value of the set he is buying, its selectivity, sensitivity, general characteristics and the reputation of the manufacturer; whereas, the layman, charmed by a glib but inexpert salesman, is in a fair way to be stuck. The serviceman's time, effort and knowledge justifies his profit.

Paul Graves, of Fonda, New York, operates a similar scheme. He accepts orders from his clients for radio receivers. He is

Figure 1. An attractive letterhead goes with the reliable, established service business

given a general idea of the type set they want and the price they are willing to pay for it. He then takes the train to Albany, shops conscientiously and buys the best receiver the money, less fifteen dollars for his expenses and profit, will cover. He writes: "I have sold nine sets this way, ranging in cost to the customer from $50.00 to $200.00, and my clients have been more than satisfied. I buy the receivers without tubes, thereby allowing myself an additional profit, and charge a $5.00 installation fee. I have no hesitancy in guaranteeing these receivers for one year, as I buy them as carefully as I would a set for my own family. When, as a matter of personal taste, the customer wishes to see the set before purchasing, we arrange a mutually convenient time for the

NAPIER IS WINNER OF RADIO CONTEST

Cottage Grove Boy Builds Best Crystal Set

Orris Napier, of Cottage Grove, won the six-tube radio given by The Radio Shop to the winner of the crystal set contest. Twenty-one boys competed for the prize, Cleo Van Ausdall winning second place; Linn Snyder, third; and Wilbur Sharp, fourth.

A prize of a set of head phones went to the second prize winner and a 100-foot aerial to the third place. All boys competing were given prizes and refreshments were served.

Miss Ethel Coleman and Miss Schneiderwind acted as judges and the awards were given at The Radio Shop, 105 College Corner Avenue.

The winning set will be displayed at Fosdick's store the latter part of this week.

Figure 2. Live publicity

trip. My customers know exactly how much I make on the deal, so I have no objection to their accompanying me on the shopping tour."

Unfortunately, the hard-of-hearing know of no "off season," and all of the twelve months are equally propitious to the sale of hearing-aid devices. Gordon Taylor, in his praiseworthy series of articles appearing in the spring numbers of RADIO NEWS, has described several hearing aids which may be made by the serviceman, and we heartily recommend industry of this order during slack shop periods.

The Service Letterhead

An attractive letterhead is an asset to any business, including radio servicing. Aside from being a good advertisement, it is the "open sesame" to many entrées. Requests for literature, discounts and samples will often be honored only when written on a business letterhead. The recipient of a letter occasionally bases his entire judgment of the writer's character and general business standing on the appearance of the letterhead. In many instances it is the only thing by which he can form an opinion.

An attractive letterhead is not necessarily an expensive one. A good grade of watermarked bond costs little more than an obviously cheap paper. Also, the average printer, by an an intelligent selection of type, good make-ready and presswork, can produce letterheads which compare favorably with the lithographed product. The samples shown in Figure 1 have all been set from readily available type fonts and provide a good idea of what can be done at a very reasonable price. Advantage should also be taken of the trade-mark cuts which many manufacturers supply free of charge to their representatives and dealers for use in advertising and on stationery.

Additional samples of inexpensive letterheads will be found on page 36 of "How to Make Money in Radio Servicing."

Publicity and Sales Promotion

The Radio Shop of Liberty, Indiana, specializes in parts, accessories, service and livewire ideas! Writes the proprietor:

"We have organized a radio amateurs' club, and have distributed among the members all our back numbers of RADIO NEWS. We stir up a lot of interest and indirect sales through set building contests. We are putting on our second contest at the present time and would like to get hold of about 20 copies of the old editions of '101 Radio Hook-Ups' for free circulation among the boys.

"The attached clipping from our local paper (Figure 2) gives you an idea of the sort of publicity we are getting. It all helps in keeping the ball rolling.

"We recommend to other dealers and service organizations this set-building contest idea. It disposes of absolete trade-ins by selling the parts to young experimenters."

THIS MONTH'S SERVICE SHOPS

Figure 3 is a photograph of the radio service laboratory operated by the Geigel Hardware Company, specialists in Victor and Sparton receivers for Monroe, Wisconsin. The equipment was designed by their radio service-manager and engineer, Mr. O. H. Haueter, who describes the laboratory as follows: (*Continued on page* 125)

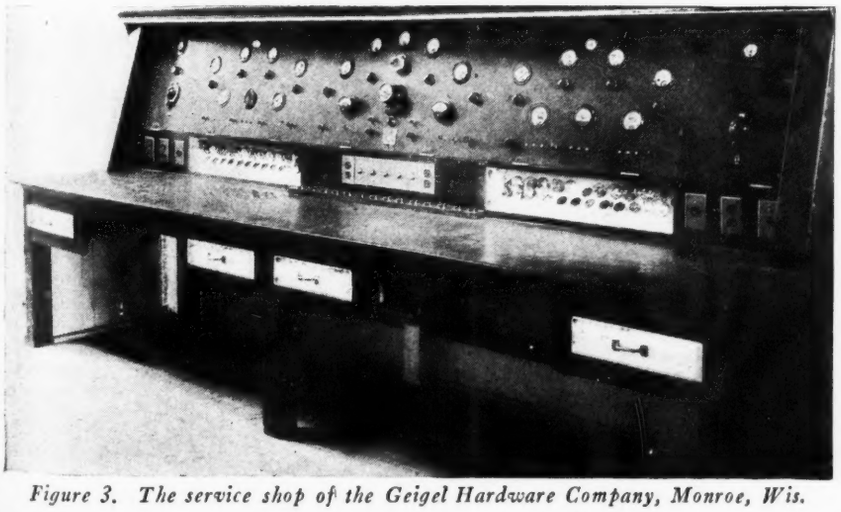


Figure 3. The service shop of the Geigel Hardware Company, Monroe, Wis.

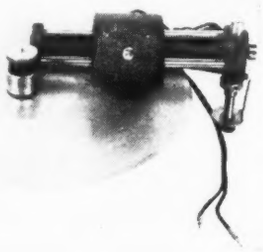
What's New in Radio

A department devoted to the description of the latest developments in radio equipment. Radio servicemen, experimenters, dealers and set builders will find these items of service in conducting their work

By The Technical Staff

Recording Unit

Description—The Acratone recording device is simple to operate and is easily installed, as it requires only a single hole for fastening to the cabinet. For efficient cutting and long life, a diamond needle is employed for recording. When ready to record, the arm of the instrument, with its attendant



gear arrangement, is placed over the center pin of the turntable and the lifting lever is brought to the "down" position. The recorder grooves its own record, and it is capable of cutting 96 grooves per inch. The blank discs for recording are made of aluminum, and this model can make records up to the 12-inch size. If desired, the finished recording disc can be specially processed, permitting the record to be played innumerable times with a steel needle. The dimensions of the recorder are as follows: Length, 9½ inches; height above turntable, 3½ inches; depth, 5 inches.

Maker—Federated Purchaser, 23 Park Place, New York City.

Short-Wave Parts

Description—The parts illustrated here are especially designed for ultra-short-wave apparatus. The socket is made of Isolantite material and is available in standard four, five and six-prong types and a special six-prong model for the National Standard size R-39 coil form. The construction features of the new s.f.l type tuning condenser are heavy double-spaced 270-degree plates, Isolantite insulation, constant low-impedance pigtail connection and an insulated front bearing. The capacity is 18 mmfd. The R-39 type midget coil form measures 1 inch in diameter by 1½ inches in length. This coil form is made of a special low-loss dielectric termed R-39. Best results are obtained from this type coil form when it is used with the Isolantite type coil socket.

Maker—The National Co., Inc., 61 Sherman St., Malden, Mass.

Electro-Dynamic Unit

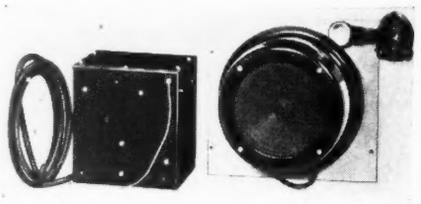
Description—This loudspeaker unit is especially suited for use in theatres, large auditoriums and any location where great volume is desired. The diaphragm is .002 inch thick and is so designed that it forms its own core for the voice coil. This coil is wound directly on the aluminum diaphragm, allowing heat to dissipate more rapidly. The construction of the unit permits easy replacement of damaged diaphragm or voice coil. It has a capacity of 25 watts on the input, not to exceed 15 volts at 2 amperes alternating current. The impedance of the voice

coil is 16 ohms and the exciting energy of the field coil is 6 to 8 volts at 1½ amperes, which is obtainable from a Fox dry rectifier unit.

Maker—Fox Electric & Mfg. Co., 3120 Monroe Street, Toledo, Ohio.

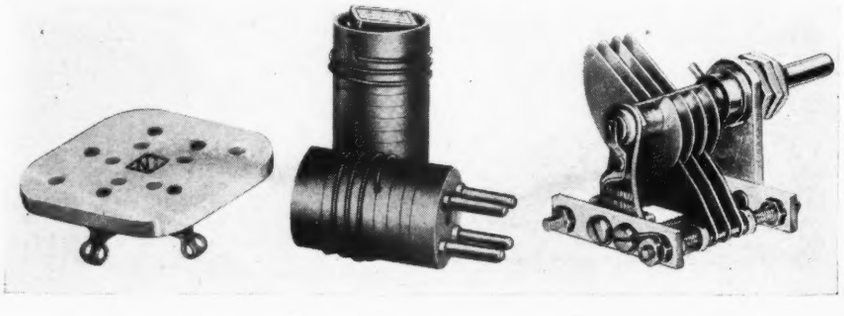
Automobile Set

Description—The "Transitone," a compact superheterodyne motor radio receiver, is



especially designed for quick and easy installation on all makes and models of automobiles and for low A and B battery consumption. It features an automatic vol-

(*Continued on page* 123)



Modern "Super" Design

(*Continued from page* 110)

only 500 ohms per section, the transformer has very good regulation and will supply the small power required by the –45 grid circuits without the wave-form distortion which would be present in the conventional high-resistance step-up coupling transformer.

The power supply is quite interesting, as it uses the new –82 mercury-vapor rectifier tube, which is more efficient than the previous –80 type, due to having a lower internal resistance and consequently much lower voltage drop (loss) across it. Due to the nature of the tube, it is prone to cause r.f. disturbances and must be carefully shielded and filtered to eliminate these disturbances. Hence the new—and necessary —practice of shielding the rectifier tube and putting r.f. chokes in its plate leads. This type of filtration alone would be insufficient in such a sensitive set, but a specially shielded power transformer does the job up completely. This transformer is shielded by having the high-potential ends of its secondary pulled out of the inside of its coil, so that the outside low-potential ends of the secondary, which are at substantially ground potential, shield the "hot" portion of the secondary. This is a simple and effective trick that eliminates much more cumbersome and expensive shielding.

The speaker field, with a 100-volt drop across it, is in the negative filter leg, and from a voltage divider across it the bias for the –45 tubes is taken, as well as operating potential for the a.v.c. tube.

From Figure 1 it can be seen that all r.f. tubes are thoroughly shielded, the i.f. tubes being dually shielded by the main tube shield and also by individual tube cans to insure high gain with perfect stability.

The tuning dial is accurately calibrated in kilocycles for the police and broadcast bands and is surmounted by the visual tuning meter. The control knobs, left to right, are volume, tone control and on-off switch, tuning with noise-suppression switch below, police-band antenna tuning, and police-broadcast selector switch.

New Tubes

(*Continued from page* 102)

When mercury vapor is introduced into the tube at low pressure, the electrons collide with the mercury-vapor atoms and knock one electron out of them. The removed electron moves with the others toward the plate. The remainder of the atom, the positive ion, neutralizes the space charge and thus reduces the internal resistance.

The potential drop in the tube is only about 15 volts and it remains fairly constant up to the rated maximum plate current. Plate current does not start until the plate voltage has risen to a fixed minimum.

The rated maximum voltages and currents should not be exceeded (see the table of characteristics). It should be remembered that the instantaneous peak voltage is 1.4 times the effective voltage and the condensers must be able to withstand this voltage.

A filter with a condenser input often causes peak currents to flow which are up to 4 times as large as the steady output current. If the full advantage is to be taken of the tube's possibilities, the choke input type of filter is recommended.

Under operating conditions, the mercury vapor tube has a bluish-white glow within the space inside the plates and to some extent outside the plates. This glow is due to ionization. The manufacturers recommend that the entire power supply be disconnected from the a.c. line when the rectifier is removed or installed in its socket.

Characteristics of Type -46 Tube

Ef	2.5 volts a.c.
If	1.75 amperes
Max. overall length	5⅝ inches
Max. diameter	2 3/16 inches
Bulb	S-17
Base	medium 5-pin

Used as Class B amplifier:

Eg (both grids tied together)	0	volts
Ep	300	400 max. volts
Ip	4	6 milliamperes
Ip (peak)	150	200 milliamperes
Load resistance per tube	1300	1450 ohms
Max. signal voltage	40	41 volts
Max. continuous power output (2 tubes)	16	20 watts
Max. plate dissipation (avg. per tube)	10	10 watts

Used as Class A amplifier:

Eg (outer grid tied to plate)	–33 volts
Amplification factor	5.6
Rp	2380 ohms
Gm	2350 micromhos
Ip	22 milliamperes
Load resistance (optimum for max. undistorted output)	6400 ohms
Load resistance for driver of Class B stage	12800 ohms
Max. undistorted output	1.25 watts

Characteristics of Type -82 Tube

Ef	2.5 volts
If	3.0 amperes
Max. a.c. voltage per plate	500 volts RMS
Max. peak inverse voltage	1400 volts
Max. d.c. output (continuous)	125 milliamperes
Max. peak plate current	400 milliamperes
Tube voltage drop, approx.	15 volts
Max. overall length	4 11/16 inches
Max. diameter	1 13/16 inches
Bulb	S-14
Base	medium 4-pin

Backstage in Broadcasting

(*Continued from page* 117)

of 573 submitted, for the $10,000 awards offered by the NBC for original symphonic works by American musicians. The awards were recently made in New York by Merlin H. Aylesworth, president of the network. Philip James, of New York, who won the first award of $5,000 for his composition "Station WGBZX," is conductor of the Little Symphony Orchestra of Station WOR, Newark, assistant professor of music at New York University and instructor of music at Columbia University. The second award of $2,500 went to Max Wald, an American resident of Paris, for his composition entitled "The Dancer Dead." Carl Eppert, of Milwaukee, earned the $1,250 award for his composition, "Traffic." Symphonic Intermezzo," by Florence Grandland Galajikian, of Maywood, Illinois, won the $750 prize. The final prize of $500 went to Nicolai Berezowsky, of New York, for his manuscript entitled "Sinfonietta."

Municipal Radio

(*Continued from page* 73)

and Structures on a non-commercial basis and attempts to present features of especial civic importance. Numerous educational talks are scheduled, but musical and dramatic presentations are also heard. The exact worth of the broadcasting station to the public has long been a subject of controversy in political and radio circles. WMCA, a New York commercial station, has had many legal skirmishes with WNYC over the matter of sharing time on the 570-kilocycle channel.

The city's welcoming steamer *Macom,* which goes down the bay to meet ocean liners conveying noted visitors to the city, is equipped with short-wave apparatus to transmit programs to WNYC for rebroadcasting. Frequently, in the instances of important public receptions, the National Broadcasting Company and the Columbia Broadcasting System are offered these programs for relay to the nation. The *Macom* short-wave transmitter is designated as WBCD. The ship is also equipped with standard marine-code apparatus.

In addition to WNYC and the floating WBCD, the Department of Plant and Structures operates short-wave station WKDX, which adjoins WNYC atop the Municipal Building. This unit is chiefly used to contact the *Macom* when it goes down the bay. WKDX was utilized in preliminary tests for the Police Department and Fire Department radio systems.

At this writing the *Macom* is being equipped with radio-telephone equipment for two-way ship-to-shore conversation via the American Telephone and Telegraph Company station, WOX, on Staten Island. Through this system, telephone calls will be made from aboard the welcoming steamer to any land telephone. Telephone calls from any land telephone to the ship will also be possible.

The city's radio systems have thus gradually expanded to form the present large municipal group. There have come reports from time to time that the city may form a special radio division to supervise all of the municipal radio projects. However, it is doubtful whether supervision of the transmitters can pass from the control of the individual city departments to which they are attached.

STUDENT TRANSMITTER

This is a duplicate of the WNYC transmitter installed at the Brooklyn Technical High School for instructions of students in radio's "mysteries"

No other city in the world has undertaken a varied assortment of radio projects similar to that of New York. However, there is no other city possessing the unique needs of this American metropolis. Municipalities throughout the world are watching with interest New York's multiple applications of radio in civic government.

Latest All Wave Super

(*Continued from page* 81)

or more distant came in well enough to be classed as "local" reception—and this was in mid-afternoon!

The following are frequencies of stations received in mid-afternoon: 560, 570, 580, 590, 600, 610, 630, 660, 690, 700, 710, 760, 780, 790, 810, 830, 860, 890, 920, 940, 950, 990, 1000, 1010, 1020, 1060, 1070, 1100, 1130, 1150, 1170, 1180, 1200, 1210, 1230, 1250, 1270, 1280, 1300, 1310, 1320, 1330, 1350, 1360, 1370, 1400, 1410, 1420, 1430, 1450, 1460, 1490 and 1500.

Another thing to be borne in mind in analyzing the results outlined here is that they are not results obtained after a long succession of tests, nor were they carried on at a time selected because of especially propitious reception conditions. The place was selected as a matter of convenience because the writer happened to be week-ending there, and the time was whatever happened to be unoccupied by other week-end activities. The season was early summer—warm enough to make swimming popular just a stone's throw from the house.

The two evening reception tests took place on Saturday (May 21 and May 28). During one of these evenings a thunderstorm occurred shortly after the evening's reception started, and static remained quite heavy throughout the evening. The other one was clear, warm and free from static. If anything, the reception was better during the evening of the thunderstorm. The static was troublesome then, but the distant stations came in with greater strength. As explained before, stations were tuned in on every broadcast channel, except 840 kc. In addition there were not fewer than six stations tuned in from Mexico and Cuba. Shortly after midnight a try was made for the West Coast stations (12:35 a.m.). KFI came in fairly strong, with only moderate fading, at that hour. Later it, as well as several other far-western stations, came in with increasing strength, providing good loudspeaker reception (except for the bursts of static the night of the storm). No serious attempt was made toward bringing in stations from other continents, because the noise level on both nights was not such as to permit it.

The mention of noise level brings up another interesting point about this receiver. It is the general feeling that any set employing as many tube as this one, especially if it be a superheterodyne, must necessarily have a high background-noise level. Actually this is far from the case, at least so far as this receiver is concerned, because the noise level was actually surprisingly low as compared with the signal level. So true was this that many stations 1000 miles or more distant were brought in with little more noise than would be experienced in listening to nearby stations. In fact, WCCO of Min-

neapolis was tuned in and, switching back and forth from this to local stations having the same chain program, a listener in the next room was asked to tell which of the two was the local. It was not until after a change had been made from one to the other three times that he could definitely decide which was which. During this test the volume control was, of course, readjusted so as to maintain the loudspeaker output substantially the same for the two stations.

When it comes right down to tuning in out-of-town stations, the real selectivity of the receiver is shown up at its best. While the "listening post" was not "under the shadow" of any broadcast transmitting antenna, still the location is a suburb of New York City and therefore close to a number of high-powered stations. Yet there was no difficulty whatsoever in tuning in out-of-town stations 10 kilocycles above and below each of these locals. The selectivity curve is shown in Figure 3.

For the DX enthusiast the accuracy and completeness of the dial calibration will be a revelation. As a matter of convenience the dial is calibrated both in degrees and in kilocycles. A careful operating check shows the maximum deviation from the frequency calibration to be less than one degree. When a station is tuned in, therefore, its frequency is read directly on the dial, the resonant position being indicated by a hair-line shadow thrown on the translucent scale. This use of a shadow instead of a pointer offers the decided advantage that the dial reading remains exactly the same, no matter from what angle it may be viewed.

Another tuning convenience is found in the local-distance switch mounted on the front panel. This switch provides three settings—local, medium and distance. The local position provides very loose coupling to the antenna and thus prevents powerful local signals from overloading the tubes and causing poor tone quality. The medium position serves the same purpose where the receiver is situated some little distance from the local stations. The distance position provides close antenna coupling and therefore maximum sensitivity when it is required for real DX reception.

It should not be gathered from this, however, that the receiver lacks sensitivity in any of the three positions. Actually, when set for local reception, this outfit is more sensitive than the average broadcast receiver—and at the same time has the advantage of a super degree of selectivity. Thus the switch serves the dual purpose of an overload regulator and a selectivity control.

From the foregoing discussion it is evident that the new Scott receiver has a great deal to recommend it to the broadcast listener. But it does not stop here. Next month an article will deal with the reception results it provides on the short-wave bands, how it actually reaches out for "round-the-world" reception from Australia and New Zealand, and how it provides regular reception from the short-wave broadcast stations of Europe and South America.

The Deaf Hear

(*Continued from page* 85)

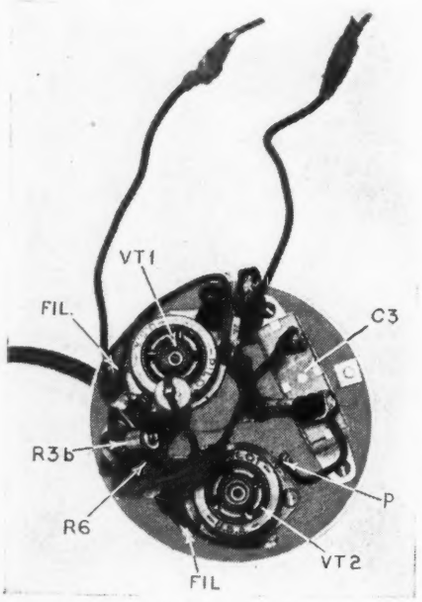
sections which fill up more slowly than others. In other theatres, there are dead spots, where the acoustics interfere with good reception. Many managers install the Theatrephone in these dead spots.

In other installations, certain rows are selected for Theatrephone seats, each alternate seat being so equipped. These seats are held back until a certain hour, and the hard of hearing patrons are advised to come to the theatre early, to be sure of getting a seat equipped to enable them to hear.

Notes on the Condenser Microphone

(*Continued from page 79*)

characteristic was concerned. The "Old Gold" diaphragm has a tendency to favor the high frequencies more than the lows, whereas the .001-inch material shows a flatter curve. The improved characteristics of the thicker material are easily detected by ear. This thicker material has one slight disadvantage in that when it is employed, the microphone is somewhat less sensitive. However, its sensitivity is still unusually high for a condenser microphone, so that this disadvantage is not sufficient to overcome the gain in quality. Further offsetting this disadvantage is the fact that the .001 duralumin is much tougher and stronger than the "Old Gold" wrapping and is therefore less likely to be damaged during the stretching process.



AMPLIFIER REMOVED FROM "CAN"
The tube sockets and C3 are the only parts fastened to the wood base. All resistors as well as C1 and C2 are supported by wiring or socket terminals

While on the subject of diaphragms, the reader should be cautioned against allowing the duralumin to become wrinkled, because, unlike tinfoil and other softer materials, duralumin cannot be rolled out smooth once it has been damaged, and inasmuch as a flat surface is essential in the diaphragm of a condenser microphone, a piece of material that has been badly mutilated will not function to best advantage, even when stretched tight.

Another important point is to make liberal use of vaseline on the edge of the case to prevent tearing the diaphragm when the face-plate is screwed down tight. Do not use oil of any kind as lubrication here.

Mr. Argabrite's warning about keeping the leads short between the microphone and the microphone amplifier is an important one. During the experiments in the Laboratory, using a two-stage head amplifier as described above by Mr. Argabrite and working the output of this amplifier into a two-stage power amplifier, it was found impossible to eliminate instability unless the head amplifier was thoroughly shielded. The method of building them both into one "can" solves the problem nicely and makes the whole system absolutely stable. Separating the microphone and head amplifier about six feet cut the output volume of this experimental set-up to a point where headphones had to be used, while before the microphone was separated from the amplifier, loudspeaker volume, audible 100 feet from the loudspeaker, was obtained. Moreover, in addition to decreasing volume, the six-foot extension cord picked up a decidedly strong hum from a nearby a.c. line, whereas with the microphone mounted on the can with the head amplifier, absolutely no hum was noticeable.

The length of the line from the head amplifier to the main amplifier is evidently of little importance. At least, a fifteen-foot cable proved to be entirely satisfactory. If it is necessary to have these leads longer than 15 feet, it will probably be best to include a transformer in the plate circuit of the second tube of the head amplifier, to permit the use of a low-impedance line. This transformer should have a primary impedance of approximately 50,000 ohms and a secondary impedance of 200 or 500 ohms. The input transformer employed in the main amplifier should, of course, have a primary impedance to correspond with the secondary impedance of the head amplifier output transformer.

Using the resistance type of output coupling shown in the diagram, Figure 1, the output of the head amplifier should be connected directly to the grid of the first tube in the main amplifier. If there is a transformer secondary in this grid circuit, it should be left in the circuit to function as a grid impedance. Otherwise it will be necessary to connect a grid leak across the input of this tube. This leak may have a value of 250,000 ohms or higher, the exact value being determined by experiment.

As a final suggestion, when connecting the microphone to the head amplifier be sure that the case of the microphone is connected to the filament circuit, thus grounding this unit. Also make certain that the "can," including the metal disc fastened to the underside of the wood base of the amplifier, is also grounded. If the microphone case, the can or the bottom disc are left ungrounded, the amplifier is likely to be unstable.

Music from Electrons

(*Continued from page 76*)

at the right side of the space-control instrument. Maximum detuning takes place if the hand touches this metal ring.

A complete set-up for simultaneously producing a plurality of musical tones on the same or different pitches is shown in Figure 7, a reproduction of the patent drawings. We see the three different osciliating systems, two for regulating the pitch of the tones, the other for controlling the volume of the output. In this system, where two loudspeakers are used at the same time, several means are embodied for the control of the timbre of the sound in various ways, thus giving a wide range of tone color. Sound qualities of known instruments can be imitated and, more important for the future development of this electronic music, *new sound qualities, unknown to the instrumentation of today,* can be produced.

Using these principles in the construction

(*Continued on page 127*)

Automobile Radio

(*Continued from page 99*)

over the head of the coil and also shield the high-tension lead as far as the dash. If the breaker-point wire runs through the same hole, it must be rerouted.

Special attention must be given to the wiring in back of the instrument panel. This is even more important if the receiver is mounted in the cowl. Quite a confusion of wires will be found here, and it will be well to segregate those that might cause trouble.

From the laws governing magnetic fields, we learn that if a conductor carrying a fluctuating voltage is doubled back on itself, its magnetic field will be neutralized. By way of illustration, if we take the wire from the battery to the ammeter and from the ammeter to the switch and twist them together, induction effects will be cancelled out and consequently its radiation.

Choke wires, oil lines, etc., coming up to the instrument panel are often an unsuspected source of trouble. Quite often it is necessary to ground them at more than one place. Generally some "node" point will be found where the ground is most effective.

It may also be necessary to place a condenser on one or more of the following instruments: ammeter, switch, electric gasoline gauge, circuit breaker, or cigar lighter.

Electrolock ignition cables, due to the spiral winding of the steel wire which covers them, are a source of disturbance. This can be rectified to some extent by placing another winding over the original one. It need only be roughly spaced but must be wound in the reverse direction. One end should be grounded and the other left open.

Radio's Evolution

(*Continued from page 83*)

sole producer of radio sets. But this is not quite the truth. Almost coincident with the first stations there were complete receivers, but their high cost limited their sales. These early instruments were plain box-like affairs with, first, three tubes, then four and finally five. The tubes were fed from storage batteries, because no one had yet refined the battery eliminator. Selectivity was incidental; sensitivity depended almost entirely on the luck of the owner in getting good tubes. Yet, despite these handicaps, the public expressed a demand for radio receivers that astonished industry and created a horde of manufacturing organizations. The radio industry had passed the childhood stage.

The next phase was one of invention. Not from the extensive research laboratories of the great corporations, but from the kitchens and cellars of the individual and the private workshops of smaller firms, came a constant stream of improvements. A grid leak ceased to be a crude pencil mark on a strip of fibre and became a carefully calibrated thread of resistance material in a glass tube. Transformers were improved and the voices of orators no longer sounded alike. Loudspeakers graduated from a combination of earphone and horn into a matched assembly of magnetic unit and air column. Refinements in accessories made it certain that the receiver could be depended upon to function, day after day and week after week. By 1923, the plaything had become an instrument, crude, of course, as compared with those of today, but imposing enough to meet all the requirements of the public except one—electrician.

In 1924, when RADIO NEWS was but six years of age, its pages carried the first stories of socket-power-operated receivers. The ponderous storage battery had done its work, and the small, compact dry cells were to be replaced. All that one needed was a connection to any handy electric-light socket. The toy stage had definitely passed and in its place came the era of utility.

Professor Hazeltine contributed his method of counterbalancing the sources of squeals, and there was no longer a definite limitation to the number of tubes that could be used.

This development came at a time when the amazing increase in broadcasting stations seemed about to curtail the usefulness of the set, due to interference. More tubes meant greater selectivity, and electrification meant that the increase in tubes could be accommodated without depleting the source of power.

During all this time the loudspeaker sat at one side of the receiver or perched on its top like an added thought—albeit a mighty essential one. Designers (with vision) saw the desirability of making the radio set a complete instrument, fit to take its place in the room alongside the piano or any other piece of furniture. Consoles appeared on the market with the speakers built into some portion of the unit. The magnetic speaker was soon replaced by the dynamic speaker; early tubes were outmoded by newer types with less hum and greater volume. Tube experts realized that the same tube could not be expected to perform efficiently in radio-frequency, detector and power stages, and their attention to these special conditions soon bore fruit. The result was an improvement in quality that brought thousands of doubting Thomases to radio stores. Undoubtedly, as we see them in retrospect, these were the halcyon days of radio.

On the transmission end of the industry, engineers had not been nodding. The rapid advance of receiving technique had produced instruments that were able to reproduce better quality than stations were actually transmitting. *But not for long!* Transmission engineers soon realized that radio could not tolerate quality no better than that of the telephone. Programs, to be acceptable, must first of all be lifelike. Orchestras must sound like orchestras; the voices of speakers must be hurtled through the air and recreated in homes with all their original timbre, intonations and nuances of tone. This called for a complete redesign of equipment, which was not long in coming, so that after ten years of broadcasting, research workers were able to point to their transmitters and say: "We are transmitting more than your receivers will recreate." And that, today, in the majority of instances, is a condition that still exists.

There is no place here to comment on the so-called "American system" of broadcasting. It has its adherents even as it has its opponents. The fact remains that commercial interests have made it possible for the highest-paid stars of theatre, opera, screen and concert stage to come into your homes and entertain you with their priceless talents. Their voices are in the air through all the hours of the day, to be enjoyed by anyone who possesses the proper combination of tubes and coils to reach out and get them.

But radio has not been limited to the relatively simple task of corralling artists in a studio, there to send their voices far and wide. To prevent satiety, there must always be variety, and the broadcasting interests have not hesitated to descend into the ground, ascend to the upper air to cross continents and oceans to satisfy the ever-broadening desires of the millions of listeners who comprise this vast audience. Microphones have been lowered to mines and tunnels; they have been carried in planes during mimic warfare and on cross-country flights; they have been placed on the dais before statesmen of all countries, and war lords of the Orient have used them to bring their messages five thousands of miles to this country.

In 1932, the fourteenth year of broadcasting, those prophetic utterances of Ayrton have at last been realized. You may claim that it is not yet possible for the householder to step to his receiver and call his friend, wherever he may be. But this is not directly a limitation of radio. Does not the amateur converse with his friends on the other side of the world? Is it not possible for any man to enter a telephone booth and by a combination of wire and radio hold conversation with the object of his interest in Buenos Aires, London or Honolulu? Do not these accomplishments meet in a sense the prophecies made over three decades ago?

So much for the present. What of the future? No man, unless he be an Ayrton or a Lodge, can determine with accuracy what form broadcasting will take in the years ahead. But there is television, with its great hopes and promises. As an adjunct to mere sound, it will add a missing quality to home entertainment. An artist *heard* is only partially appreciated; the same performer *heard* and *seen* must have twice the appeal. But just how soon this accessory to sound broadcasting will be offered as a market commodity, no one knows with certainty. Is it not sufficient at this time to realize that it is coming and that its arrival can scarcely fail to herald the beginning of another fourteen-year era of wonderful accomplishment, in all of which RADIO NEWS will participate just as it has shared in the fourteen years that have led up to the day?

What's New in Radio

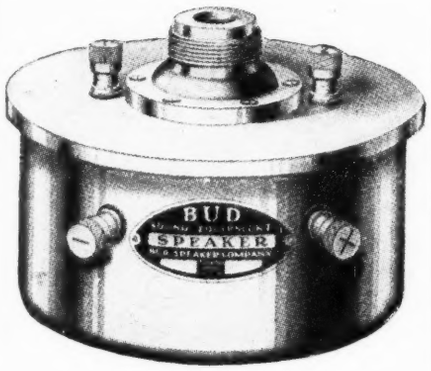
(*Continued from page* 116)

ume control to eliminate signal fading, an electro-dynamic speaker and a special image rejector circuit to reduce interference.

Maker — Philadelphia Storage Battery Company, Philadelphia, Pa.

Loudspeaker Unit

Description—A loudspeaker unit, designed for public-address requirements. The diaphragm assembly is made in one piece and is unaffected by temperature or humidity conditions. The diaphragm, made from a new light-weight metal of unusual strength, measures .002 inch thick. It is so constructed



as to form its own core for the voice coil. This new design permits the operator to make a diaphragm or coil replacement in a few minutes. The impedance of the voice coil is 16 ohms and the field resistance 4 ohms. The voltage for the field coil is 6-8 volts d.c. at 1½ amperes, which is procurable from a storage battery or a specially designed Bud exciter unit. This loudspeaker unit will handle 25 watts input.

Maker—Bud Speaker Co., 625 Board of Trade Bldg., Toledo, Ohio.

"Professional" Receiver

(*Continued from page* 91)

two broken lines (at this point on the calibration curve) shows the frequency range which will be covered by the 100-degree scale of the band-spread dial.

If desired, the tank condensers may be tune to either the high or low ends of the desired band with the band-spread dial set at zero or 100, as the case may be, instead of 50. The band-spread effect will be the same in any case, but by following the latter method it is unnecessary to calculate the center of the desired band.

A good idea of the unusual sensitivity and the high degree of selectivity provided by the receiver will be obtained from the curves, Figures 5 and 6. The sensitivity curve, Figure 5, shows that this receiver is better than five times as sensitive as the average modern broadcast receiver. To check this a study was made of the average sensitivity of twenty such receivers. The resulting figures, when averaged, show a sensitivity of 11.5 microvolts (absolute) as compared with an average of slightly over 2 microvolts for the Comet "Pro" when used for the reception of voice signals. For c.w. reception the sensitivity of the "Pro" is still better, averaging better than 1 microvolt absolute.

The sensitivity curve of Figure 5 was

made in accordance with standard measurement practice and indicates the signal strength required to produce an output of .006 watt (for headphone standard). If the power-amplifier stage that is available for use with this receiver were connected up and

TYPE OF SERVICE AND RANGE IN METERS	BAND KC. OR METERS	COILS	OSC. TANK COND.	WAVELENGTH TANK CONDENSER	BAND-SPREAD DIAL
20.82-21.42 AMATEUR	14,000 KC 14,200 14,400	A	47	50	27 50 72
39.98-42.83 AMATEUR	7,000 KC 7,150 7,300	B	40	44	13 50 89
74.96-85.66 AMATEUR	3,500 KC 3,750 4,000	C	34	41	0 50 96
148.9-174.8 AMATEUR	1,715 KC 1,850 2,000	D	305	29	0 50 100
25.0-26.0 BROADCAST	26.0 M. 25.5 25.0	A	265	285	2 50 95
30.0-32.0 BROADCAST	32.0 M. 31.0 30.0	B	795	850	16 50 82
48.0-50.0 BROADCAST	50.0 M. 490 480	B	245	270	3 50 99
500-52.0 BROADCAST	52.0 M. 51.0 500	B	205	235	0 50 94
520-54.0 BROADCAST	54.0 M. 53.0 52.0	B	165	195	4 50 95
122-124 POLICE	124.0 M. 123.0 122.0	D	64	68	45 50 55
175-190 POLICE	190.0 M. 182.0 175.0	D	185	150	18 50 82

EFFECTIVE BAND SPREADING

Figure 3. This chart shows the more common amateur and short-wave broadcast bands, and how they are spread out by the band-spread dial

the sensitivity measurements made on the basis of the standard loudspeaker output power (.05 watt), the scensitivity curve would be somewhat better than that shown because the addition of the power stage would raise the .006 watt output by approximately the square of the gain obtained in the power stage. It is therefore evident that comparing the sensitivity curves as shown for this receiver with those for broadcast receivers is perfectly legitimate.

The point of this comparison between the sensitivity of the "Pro" and broadcast receivers is to refute the common impression that it is impossible to obtain as much amplification of short-wave signals as of signals in the regular band. It is probably true that the *average* short-wave receiver does not provide as much amplification as the *average* broadcast receiver, but the performance of the receiver discussion proves that it can be done—handsomely. The sensitivity shown in these curves, plus the better carrying power of high-frequency signals, explains why this receiver is capable of receiving short-wave broadcast signals, from all over the world, without any difficulty whatsoever. And also why it becomes a simple matter to copy low-power amateur c.w. from any country that permits amateur radio stations to operate. A quotation from a letter received from Nat Pomeranz, a well-known amateur who owns and operates W2WK and W2APD, offers an interesting commentary on the utility of the receiver:

"Thus far (after using the 'Pro' for one day), most of the better-known foreign short-wave broadcast stations have been received, some with remarkable clarity. Amateur signals have been received from most of the more active countries. Signals from police transmitters have been so many that a real QRM conditions exists in that band near 120 meters. On the amateur 'phone band on 80 meters, a four-way QSO was heard between a 'six' in California, a 'five' in Mississippi, a 'nine' in Chicago and a 'two' in New York. The 'five' and 'six' came in with just as much a wallop as the eastern stations."

The selectivity curves of Figure 6 require little explanation. Here again a rather common belief that 10 kilocycle selectivity is out of the question on the shorter wavelengths

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☐ Television ☐ Short Waves ☐ New Hook-Ups
☐ Servicing ☐ Auto Radio ☐ New Tube Data
☐ Mathematics in Radio

is contradicted. Absolute 10-kilocycle separation is shown to fifteen times down, which means that a station operating on a channel 10 kilocycles off resonance and having fifteen times the field strength of the station tuned in will not cause any interference. A station operating 20 kilocycles off resonance would have to have a field strength 2500 times greater than the station tuned in to cause interference. These curves actually show better selectivity than do many of the present-day broadcast receivers and are so much better than those of most short-wave receivers that there is no comparison.

Next month the schematic circuit of the "Pro" receiver will be shown, together with a more detailed description of the design and components.

The Service Bench

(*Continued from page* 115)

"The panel, which measures 3 feet by 5 feet, is built around a Jewell model 581 analyzer. In the lower left corner is a built-in oscillator with output meter. Upper left is a low-range ohmmeter. To the right of the speaker (center) is a tube tester and in the upper right a high-range ohmmeter. A portable oscillator and set analyzer are on the bench. The test panel represents an outlay of about $550.00."

Mr. Haueter continues with some interesting points on servicing in general, which, by the way, he considers an excellent field for the university graduate.

"Radio servicing is a fascinating occupation, and when it becomes a hobby to render the most efficient service possible, its possibilities are unlimited. We believe that we can best earn sales through service, and there we have made it a point to put any kind of a receiver in working order—regardless of how hopeless the case may appear. This gives us an introduction to people who have poor or obsolete receivers in their homes and the information gained is put to good use in making future sales.

"And servicing itself pays us big dividends. It is not unusual for us to have as many as fifteen receivers in the shop at one time. While we are dealers ourselves, we do repair work for other dealers within a radius of fifty miles. Our installation charge is $7.50, and we charge "labor" on other service work at the rate of $1.50 per hour.

"The writer is a graduate (electrical engineering) of Zurich University, in Switzerland, is a member of the American Radio Relay League and operates amateur station W9GJU."

Last on this month's roster is Gray's Radio Repair Shop of Baltimore, Maryland, Figure 5. The features of this establishment

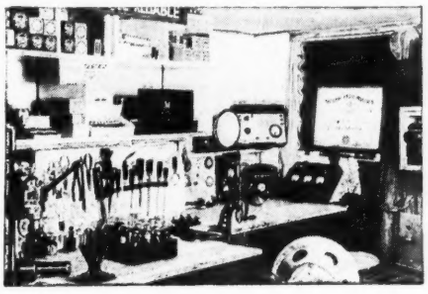

FIGURE 5

are the power drill press, tube and resistor displays and the tube box. "Tubes tested free!" provides a subtle but sound sales argument.

Radio Abstracts

(*Continued from page* 104)

Motor Radio Noises. This interesting and useful folder, published by the International Resistance Company, shows how to overcome motor-generator, ignition, coil, interrupter and spark-plug noises in automobile radio installations.

11. *Flechtheim 1932 Condenser Catalog.* This 4-page folder gives complete specifications and list prices on the line of both high and low-voltage paper condensers for by-

(*Continued on page* 126)

Radio Abstracts

(*Continued from page* 125)

pass and filter use in transmitting and receiving equipment. Units for both original and replacement use are listed.

12. *Certified Triad Tube Plan Booklet for Servicemen and Dealers.* This booklet explains in detail a special plan of the Triad Mfg. Co. which makes it possible for servicemen and dealers who maintain a service department to obtain certified Triad tubes direct from the factory at discounts which enable them to make tube replacements at attractive profits. Distribution of this folder is restricted exclusively to servicemen and dealers who maintain a service department.

13. *The Pacent Descriptive Folder for No. 108 Oil-Damped Phonovox.* Describes a phonograph record-reproducing unit designed to meet every requirement of broadcasting stations, talking-picture houses and homes.

14. *The Pacent Descriptive Folder for No. 120 and No. 160 Phonovox.* Contains complete operating notes on both of the popular-priced electric phonograph reproducers.

15. *The Pacent Booklet for the No. 171 Recordovox and Control Box.* Detailed descriptions, specifications, installation and operating notes on a versatile combination instrument for both making and reproducing records electrically through standard radio receivers.

16. *Lynch RMA Standard Resistor Color-Code Chart.* This handy postcard-size resistor color-code chart can be carried in pocket, notebook or kit of tools. It has been designed to simplify the job of identifying the resistance values of resistors used in most of the standard receivers.

17. *Weston and Jewell 1932 Radio Instrument Catalog WJ.* A 20-page book on radio measuring and testing instruments, containing specifications on the complete lines of both the Weston and Jewell organizations, that is without doubt the most complete of its kind. A copy should be in the hands of every engineer, serviceman, purchasing agent, teacher or anyone in the industry who uses or specifies measuring and testing instruments.

August, 1932
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Music from Electrons

(*Continued from page* 120)

of new musical apparatus, a number of designs can be made so as to suit the different needs of the musician and the composer.

Figure 8 shows the so-called "keyboard" instrument. Here the various electrical changes of the oscillating circuits are not produced by waving the hands in the air. In this case, the keyboard serves as a scale upon which the distances between the separate tones are analogous to the distances upon the keyboard of an organ. If the main tuning has been made exact—it is done by the calibration upon the dial at the right side of the board—then the mutual distances of the tones upon the piano are right. With the aid of the two pedals (and the "stops" at the left side), special sound qualities can be produced.

Another instrument, called the "fingerboard" instrument (the latest development in the line of musical designs of Theremin), is shown in Figure 9. This instrument is held between the knees like a cello. The left-hand fingers control the pitch of the sound by pressing on an elastic surface. The right hand moves a lever which controls the sound volume. This is drawn in detail in the diagram, Figure 10. At the back of the board is attached a fine slide-wire rheostat R. The lever, if not operated, is drawn upwards by a spring, so that it touches the right side of the resistance. Under these circumstances, no sound occurs. If the lever is pressed down, the contact slides towards the left side, and the volume of the sound moves toward a maximum. The resistance itself is a wire-wound resistor over which a thin sheet-metal is attached, which is pressed down by the sliding arm. Thus it is possible to change, continuously and without a jump, the volume of the tone, the pitch of which was determined by the position of the left-hand fingers.

For all three instruments, the actual sound reproduction takes place through a loudspeaker.

Below Ten Meters

(*Continued from page* 97)

chassis. The location of this point is not particularly critical, but should be fairly well isolated from the coil shields. Individual grounding at different points results in the existence of r.f. currents in the chassis, often with an appreciable interaction. Also the coils tend to set up similar currents, and if various by-pass condensers are grounded to a point in an area of slight r.f. potential, a certain amount of feedback is bound to be introduced, with resulting instability. I.f. circuit stability is particularly important when it is remembered that the detector regeneration control is also effective in varying the i.f. gain.

A receiver of this type should be mounted in a metal cabinet provided with a metal top, as it is rather difficult to shield the first detector grid circuit (without introducing excessive capacity) from i.f. currents and other strays to which the trap circuit is susceptible.

Another source of instability is feedback through the oscillator-coupling lead connecting to the grid of the first detector. This lead should be connected directly from the plate, through the blocking condenser and coupling resistor to the grid of the tube, and in no way exposed to an intermediate-frequency field. In Figure 4, the detector compartment may be seen adjoining the front panel. The rear compartment contains the oscillator, the padding condenser being mounted above the oscillator tuning condenser, on the end of the can.

Parts List

The parts required for the ultra-short-wave "super" have been suggested in the wiring diagram, and several values have already been indicated in the accompanying text. The recommended parts, which are listed below, may be obtained singly or in a complete construction kit.

1 National chassis, type USW, including shields, cans, sockets, etc.
1 set National ultra-short-wave coils, type USA, USO, UST, USX and USB, respectively (L1, L2, L3, L4 and L5)
3 National intermediate-frequency transformers, type USI (T1, T2 and T3)
1 two-gang National tuning condenser, type SEU, 12 mmfd. (C2 and C3)
1 National antenna series condenser, type USC, 1 mmfd. (C1)
1 National padding condenser, type ST, 8 mfd. (C4)
1 National trimming condenser, type ST, 2 mfd. (C5)
5 compression-type condensers, 4-70 mmfd. (C6, C12, C13, C15 and C26)
3 Aerovox .5 mfd. condensers (C7, C9 and C11)
6 Aerovox .01 mfd. condensers (C8, C10, C14, C16, C20, C24, C25 and C27)
2 Aerovox .001 mfd. condensers (C17 and C18)
4 Aerovox .0001 mfd. condensers (C19, C21, C22, C23)
2 Lynch 100,000-ohm resistors (R1 and R7)
3 Lynch 5-megohm resistors (R2, R3 and R13)
2 National variable 50,000-ohm resistors, type USR (R4 and R10)
3 Electrad type C voltage dividers with necessary clips, 10,000 ohms (R5 and R16)
3 Lynch 20,000-ohm resistors (R6, R8 and R12)
2 Electrad wire-wound 500-ohm resistors (R9 and R11)
1 Electrad wire-wound resistor (220 ohms (R14)
1 Electrad wire-wound, center-tapped resistor, 60 ohms (R15)
1 National input transformer, type P-50 (T4)
1 National output transformer, type P-11 (T5)

Adjustment and Operation

The indicated voltages should be applied to the tuner from an adequate power supply and the taps adjusted on resistors R5 and R16 until the tube voltages at points 1, 2 and 3 are respectively 67.5 volts, 135 volts and 135 volts.

The controls shown on the front-panel layout and photograph are, from left to right: first detector regeneration, first detector trimmer, tuning control, i.f. gain and heterodyne-oscillator switch. The adjustment and operation, in general, are similar to corresponding operations on a conventional superheterodyne. The intermediate-frequency amplifier should first be lined up

with the aid of a local oscillator, coupling directly to the grid of the first detector tube. The high side of the coupling should then be transferred to the high-potential side of C2 and the connection opened between the high side of C2 and L1. Condenser C6 should then be adjusted for minimum signal. This will tune the trap circuit to the intermediate frequency.

In operation, the trimmer should be adjusted for the greatest background hiss. The regeneration control is operated in the usual manner—up to the oscillation point. When the detector spills over, the receiver ceases to function, due to overload change in bias, etc. The operator will readily become accustomed to this minor peculiarity.

The receiver described above is the result of experimentation over a period of years, brought up to date with reception tests from the most modern ultra-short-wave transmitters. The predominant contrasts between this superheterodyne and the best of the super-regenerators are increased selectivity and sensitivity. While ease of control is in favor of the super-regenerator, these two advantages in the present receiver more than justify its use.

A signal which is just above the threshold value on the super-regenerative receiver is easily tuned in on the superheterodyne without adjustment of the oscillator trimming condenser. With the aid of this last-named control the signal can be easily brought up to loudspeaker volume, demonstrating the superiority of the superheterodyne.

In addition to co-operation from several amateur stations, tests have been made on signals transmitted from the Empire State Building, New York City, at a distance of 15 miles, with results indicating an excellent degree of selectivity, with a sensitivity unapproached by any other type of ultra-high-frequency receiver.

C. C. I. R.

(*Continued from page 77*)

the C. C. I. R. for the International Radiotelegraph Conference of Madrid.

OPINION No. 34: Organization of a commercial radiotelephone service between mobile stations and the land network.

Annex 1: Recommendations relating to the organization of a commercial radiotelephone service between mobile stations and the land network.

Annex 2: Resumé prepared by the German Administration.

OPINION No. 35: Co-ordination of radiotelephony between fixed stations with telephony over the land network.

OPINION No. 36: Extension of a radiotelephone connection in case of unfavorable radio conditions.

OPINION No. 37: Frequency List.

OPINION No. 38: Precision in the indication of frequencies and wavelengths.

OPINION No. 39: Assignment of a separate call signal to each frequency used in the fixed service.

OPINION No. 40: Definition of the power of a transmitter.

Annex.

OPINION No. 41: Tolerances.

OPINION No. 42: Definition of terms relating to the measurement of frequencies. Method of comparison of frequency standards.

Annex: Decision adopted by the International Committee on Weights and Measures.

OPINION No. 43: Degree of precision of radio-frequency meters and frequency indicators.

OPINION No. 44: Reduction of interference in the shared bands for frequencies above 6000 kilocycles.

OPINION No. 45: Technical methods of stabilization.

OPINION No. 46: Reduction of non-essential emissions.

OPINION No. 47: Reduction of the frequency band of a transmitter.

Annex: General report of the Austrian Administration.

Annex 1: Procedure adopted to obtain systematic answers to question 7 of the program.

Annex 2: Answer of the Administration of the United States of America.

Annex 3: Answer of the German Administration.

Annex 4: Answer of the Japanese Administration.

OPINION No. 48: Suppression of harmonics and permissible tolerance for their intensity.

Annex 1: Answer of the German Administration.

Annex 2: Answer of the Japanese Administration.

OPINION No. 49: Tolerance of overmodulation of radiotelephone transmitters.

Annex: Answers of the Administration of the United States of America.

OPINION No. 50: Suppression of negative currents in arc transmitters.

Annex: Study of the Polish Administration.

The action taken by the C. C. I. R. has often very far-reaching results. A case in point is the recommendation of the first meeting of the C. C. I. R., which stated that the communication stations of the world could in general operate with a frequency separation of 0.1%. This action, originally proposed by the United States, led to a revision by the Federal Radio Commission of the existing allocation of commercial frequencies which practically doubled the number of frequencies available for such assignments.

The Copenhagen Conference, in view of the approaching World Radio Conference of Madrid, to be held in September, 1932, proposed that all the opinions expressed by the first two meetings of the C. C. I. R., together with the results obtained by May 1, 1932, of the fourteen questions to be discussed at the next meeting of the C. C. I. R., should be transmitted to the Berne Bureau for circulation prior to the Madrid Conferernce, in order that these technical studies may furnish an appropriate background for the consideration of the regulatory questions which will be decided by the Madrid Conference.

In closing, it is well to state that in addition to the technical advantages which accrue from these meetings, they provide an opportunity for close and intimate contact between the radio engineers of the world, thus hastening and encouraging the spread of information among the men who directly operate practically all of the international radio services. Such meetings also result in the making of international friendships, and the close fellowship resulting therefrom often permits the settling of problems, which at a distance of 3000 miles, appear formidable.

The Madrid Conference will be the most important communication conference that the world has ever held, and much time and attention have been devoted to the preparation of proposals for this conference. Its results will be reflected in world-radio legislation for the next five years.